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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 7449/57723

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 09/403813

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP99/00952	February 26, 1999	February 27, 1998

TITLE OF INVENTION Control Device, Control Method, Information Processing Apparatus, Information Processing Method, Communication system, and

APPLICANT(S) FOR DO/EO/US Masatoshi Ueno

524 Rec'd PCT/PTO 26 OCT 1999

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [ ] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau).
   - b. [x] has been transmitted by the International Bureau.
   - c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [x] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   - b. [ ] have been transmitted by the International Bureau.
   - c. [ ] have not been made; however, the time limit for making such amendemnts has NOT expired.
   - d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [x] Other items or information:
    1.) Drawings
    2.) International Search Report
    3.) References Cited in the International Search Report
    4.) International (WO) Publication (Cover Page)

(January 1996)

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17. [x] The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)): Search Report has been prepared by the EPO or JPO .... $970.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) .... $ No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... $ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... $ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) .... $		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 970.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	22 - 20 =	2	X18.00	$ 36.00	
Independent claims	7 - 3 =	4	X78.00	$312.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $	$	
TOTAL OF ABOVE CALCULATIONS =				$ 348.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 1,318.00	
				Amount to be: refunded	$
				charged	$

a. [x] A check in the amount of $ 1,318.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. ______________ in the amount of $____________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-3125. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Jay H. Maioli
Cooper and Dunham LLP
1185 Avenue of the Americas
New York, NY 10036

Jay H Maioli

SIGNATURE

Jay H. Maioli

NAME

27,213

REGISTRATION NUMBER

16/PRTS

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DESCRIPTION

CONTROL DEVICE, CONTROL METHOD, INFORMATION PROCESSING APPARATUS, INFORMATION PROCESSING METHOD, COMMUNICATION SYSTEM AND COMPUTER-READABLE MEDIUM

TECHNICAL FIELD

This invention relates to a control device, a control method, an information processing apparatus, an information processing method, a communication system and computer-readable medium, which are preferably applied to, for example, a wireless network.

BACKGROUND ART

With advances in the widespread use of portable devices such as a notebook personal computer, an electronic pocketbook, various analog and digital interfaces have made progress in wireless form and speed-up in recent years. In regard to computer's fields in particular, wireless and speed-up efforts grow prosperous, and a construction of a non-contact connection-based network has been put forward between portable devices as well as tabletop devices by using techniques typified by a wireless LAN (local area network) and IrDA (infrared data association).

For example, the wireless LAN makes it possible to provide communications between a plurality of nodes through the use of an access control protocol called "CSMA (carrier sense multiple

access)". Further, for example, the IrDA allows communications to be made between two nodes through the use of an access control protocol called "IrLAP (infrared link access protocol)".

However, since the portable devices used in the wireless network have such a character that it is possible to carry them easily, it is conceivable that the portable devices connected with the network are not able to communicate when they are carried out the network or when, as a result of carrying them, an obstruction is existed.

In such case, for example, if a data-sending permission signal is sent to any portable device that is not in a condition of communication, this portable device may not be timed to send data at a data-sending permission moment. Further, if the portable device sends the data, other portable device may not receive the data. In this case, this communication results in that nothing is communicated and then, it comes to naught and prevents an operation of the network with a high degree of efficiency.

An object of the present invention is to eliminate from the network the portable devices in poor communication condition to avoid the waste communication, and to improve the efficiency of communication.

DISCLOSURE OF THE INVENTION

A control device according to this invention is a control device for controlling pieces of controlled apparatus performing

communications within a network, comprising a determining means for determining whether the controlled apparatus is normally controlled corresponding to a signal from the control device, a measuring means for measuring a duration of abnormally controlled period of time when the determining means determines that the controlled apparatus is abnormally controlled corresponding to a signal from the control device, and a deallocating means for deallocating an identifier allocated to the controlled apparatus for identifying the controlled apparatus when the duration measured by the measuring means exceeds a predetermined period of time. Another control device according to this invention is a control device further comprising a use-restriction-lifting means for lifting a use restriction on the controlled apparatus to allow the identifier deallocated by the deallocating means to be allocated to any of the pieces of controlled apparatus after a predetermined period of time has elapsed.

A control method according to the invention is a control method of a control device for controlling pieces of controlled apparatus performing communications within a network, comprising a determining step for determining whether the controlled apparatus is normally controlled corresponding to a signal from the control device, a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the determining step that the controlled apparatus is abnormally controlled corresponding to a signal from the

control device, and a deallocating step for deallocating an identifier allocated to the controlled apparatus for identifying the controlled apparatus when the duration measured in the measuring step exceeds a predetermined period of time. Another control method according to this invention is a control method further comprising a use-restriction-lifting step for lifting a use restriction on the controlled apparatus to allow the identifier deallocated in the deallocating step to be allocated to any of the pieces of controlled apparatus after a predetermined period of time has elapsed.

A computer-readable medium according to the invention is a computer-readable medium for recording a program allowing a computer in a control device for controlling pieces of controlled apparatus performing communications within a network to carry out a determining step for determining whether the controlled apparatus is normally controlled corresponding to a signal from the control device, a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the determining step that the controlled apparatus is abnormally controlled corresponding to a signal from the control device, and a deallocating step for deallocating an identifier allocated to the controlled apparatus for identifying the controlled apparatus when the duration measured in the measuring step exceeds a predetermined period of time. Another computer-readable medium according to this invention is a computer-readable medium for further recording a program

carrying out a use-restriction-lifting step for lifting a use restriction on the controlled apparatus to allow the identifier deallocated in the deallocating step to be allocated to any of the pieces of controlled apparatus after a predetermined period of time has elapsed.

Further, an information processing apparatus according to this invention is an information processing apparatus connected to a control device through a network and controlled by the control device comprising a determining means for determining whether or not it is normally controlled corresponding to a signal from the control device, a measuring means for measuring a duration of abnormally controlled period of time when the determining means determines that it is abnormally controlled corresponding to a signal from the control device, and a deallocating means for deallocating an identifier allocated thereto from the control device when the duration measured by the measuring means exceeds a predetermined period of time.

Additionally, an information processing method according to this invention is an information processing method of an information processing apparatus connected to a control device through a network and controlled by the control device comprising a determining step for determining whether or not it is normally controlled corresponding to a signal from the control device, a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the

determining step that the controlled apparatus is abnormally controlled corresponding to a signal from the control device, and a deallocating step for deallocating an identifier allocated thereto from the control device when the duration measured in the measuring step exceeds a predetermined period of time.

A computer-readable medium according to the invention is a computer-readable medium for recording a program for allowing a computer in an information processing apparatus connected to a control device through a network and controlled by the control device to carry out a determining step for determining whether it is normally controlled corresponding to a signal from the control device, a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the determining step that it is abnormally controlled corresponding to a signal from the control device, and a deallocating step for deallocating an identifier allocated thereto from the control device when the duration measured in the measuring step exceeds a predetermined period of time.

Still further, a communication system according to the invention comprises a control device and pieces of controlled apparatus controlled by the control device in which each of the device and apparatus are communicated with each other. The control device includes a first determining means for determining whether the controlled apparatus is normally controlled corresponding to a signal from the control device, a first measuring means for measuring a duration of abnormally

controlled period of time when the first determining means determines that the controlled apparatus is abnormally controlled corresponding to a signal from the control device, and a first deallocating means for deallocating an identifier allocated to the controlled apparatus for identifying the controlled apparatus when the duration measured by the first measuring means exceeds a first predetermined period of time. The controlled apparatus device includes a second determining means for determining whether it is normally controlled corresponding to a signal from the control device, a second measuring means for measuring a duration of abnormally controlled period of time when the second determining means determines that it is abnormally controlled, and a second deallocating means for deallocating an identifier allocated thereto from the control device when the duration measured by the second measuring means exceeds a second predetermined period of time.

In the present invention, the control device determines whether the controlled apparatus is normally controlled corresponding to a signal from the control device, for example, a sending permission signal, measures a duration of abnormally controlled period of time, and deallocates an identifier allocated to the controlled apparatus when the duration exceeds a predetermined period of time (first time). Further, in this invention, the controlled apparatus device (an information processing apparatus) determines whether it is normally

controlled corresponding to a signal from the control device, measures a duration of abnormally controlled period of time, and deallocates identifier allocated thereto from the control device when the duration exceeds a predetermined period of time (second time). Thereby, it is possible to eliminate from the network the portable devices in poor communication condition, thereby avoiding the waste communication, and improving the efficiency of communication. Further, in this invention, the control device allows the deallocated identifier to be allocated to any of the pieces of controlled apparatus after a predetermined period of time (third time) has elapsed. In this case, a setting such that the third time is set as being longer than the second time allows the identifier deallocated by the control device to be allocated to any of the pieces of controlled apparatus after it has been deallocated from a controlled apparatus thus already allocated. Thereby, this avoids failing to allocate the same identifier to pieces of controlled apparatus in duplicate and enables the communication stability to be maintained.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a systematic diagram showing a wireless network illustrated as an embodiment;

Fig. 2 is a block diagram illustrating a configuration of a node for the wireless network;

Fig. 3 is a diagram for explaining a configuration of the node ID;

Fig. 4 is a diagram showing a basic format of a packet compliant with the IEEE1394 Standard;

Fig. 5 is a diagram illustrating a data format of an asynchronous packet compliant with the IEEE1394 Standard;

Fig. 6 is a diagram illustrating a data format of an isochronous packet compliant with the IEEE1394 Standard;

Figs. 7A to 7C are respectively diagrams depicting the type of data block and the contents of each header;

Fig. 8 is a diagram showing a data format of an access·layer·command;

Fig. 9 is a diagram illustrating a radio communication data format using infrared rays;

Fig. 10 is a diagram depicting a data format of a cycle start packet compliant with the IEEE1394 Standard;

Fig. 11 is a diagram showing a structure of cycle time data;

Fig. 12 is a diagram illustrating an example of an allocation of time slots;

Figs. 13A to 13E are diagrams for describing a data block conversion and a packet reconfiguring processing operation;

Figs. 13A through 13E are respectively diagrams for describing operations for a data block conversion and a packet reconfiguration;

Fig. 14 is a diagram showing the contents stored in storage areas about each node ID;

Fig. 15 is a flowchart for describing a control operation

for a node initializing process;

Fig. 16 is a flowchart for describing a control operation for a node ID deallocating process;

Fig. 17 is a flowchart for describing a control operation for a process for monitoring the communication state in the control node;

Fig. 18 is a flowchart for describing a control operation for a sending permission node determining process;

Fig. 19 is a diagram for describing a process for monitoring the communication state in the controlled node; and

Fig. 20 is a diagram for describing a control operation of a delaying process for using the identifier again in the control node.

BEST MODE FOR CARRYING OUT THE INVENTION

Fig. 1 shows an example of a configuration of a wireless network 1 using infrared rays as a radio communication medium. The present network 1 has five wireless network nodes (hereinafter called 「WN nodes」) 2 through 6.

The WN node 2 is electrically connected to an IEEE1394 bus 21. Further, a satellite broadcasting receiver 22, a receiving device (set top box) 23 for CATV (cable television), a digital video disk (DVD) device 24 and a videocassette recorder (VCR) 25 are electrically connected to the bus 21 as IEEE1394 nodes. Incidentally, an antenna 26 for receiving a satellite-broadcasting signal is electrically connected to the

satellite-broadcasting receiver 22. A cable 27, through which a CATV signal is transmitted, is electrically connected to the CATV set top box 23.

The WN node 3 is electrically connected to an IEEE1394 bus 31. Further, a video camera 32 used as an IEEE1394 node is electrically connected to the bus 31. The WN node 4 is electrically connected to an IEEE1394 bus 41. A monitor 42 used as an IEEE1394 node is electrically connected to the bus 41.

The WN node 5 is electrically connected to an IEEE1394 bus 51. Further, a computer 52 used as an IEEE1394 node is electrically connected to the bus 51. The WN node 6 is electrically connected to an IEEE1394 bus 61. Further, a monitor 62 used as an IEEE1394 node is electrically connected to the bus 61.

When data is transferred from a first node connected to a given WN node to a second node connected to another WN node in the wireless network 1 shown in Fig. 1, the data is converted to an infrared-ray signal and then the converted infrared-ray signal is transferred.

Incidentally, in the IEEE1394 Standard, up to the sixty-three nodes can be connected to the IEEE1394 bus. Node ID is composed of a bus ID (BUS_ID; 10 bits) indicating the bus to which the node is connected, and a physical layer ID (PHY_ID; 6 bits), which is a serial number in the bus. Therefore, the maximum number of buses enable to be connected to the network is 1023. Bus ID of each node having not yet set up (for example,

when the power is turned on) is set to an initial value (3FF). Further, unique device IDs other than the node ID are previously allocated to all of the nodes.

On the other hand, in the IEEE1394 Standard, data is transferred with a packet as a unit. Fig. 4 shows a data format at the execution of data communications compliant with the IEEE1394 Standard, i.e., a basic format of a packet. That is, the packet roughly comprises a header, a transaction code (tcode), a header CRC, user data, and data CRC. The header CRC is produced based on a header alone. In the IEEE1394 Standard, a node is defined so as to prohibit a header, which fails to pass a check of the header CRC, from performing an action thereon and responding thereto. In the IEEE1394 Standard as well, the header must contain the transaction code. The transaction code will define the classification of a principal packet.

Further, in the IEEE1394 Standard, an isochronous (synchronous) packet and an asynchronous (non-synchronous) packet are known as derivatives of the packet shown in Fig. 4. They are distinguished from each other by the transaction code.

Fig. 5 shows a data format of the asynchronous packet. In the asynchronous packet, a header comprises an identifier (destination_ID) for a destination node, a transaction label (tl), a retry code (rt), a transaction code (tcode), priority information (pri), an identifier (source_ID) for a source node, information (destination_offset, rcode, reserved) inherent in packet type, data (quadlet_data, data_length, extended_tcode)

inherent in packet type, and a header CRC.

Fig. 6 shows a data format of the isochronous packet. In the isochronous packet, a header comprises a data length (data_length), a format tag (tag) of isochronous data, an isochronous channel (channel), a transaction code (tcode), a synchronization code (sy), and a header CRC.

The above-described packets (isochronous packet, asynchronous packet) compliant with the IEEE1394 Standard can be varied in length as already known. In the present embodiment, however, data is transferred from a certain WN node to another WN node with a data block having a fixed length as a unit. Therefore, each of the WN nodes employed in the present embodiment creates a fixed-length data block from packet data such as an isochronous packet, an asynchronous packet based on the IEEE1394.

When the length of a variable-length packet is now longer than that of the fixed-length data block, the corresponding packet is divided into plural forms and then data in the corresponding packet is set so as to be contained in a plurality of data blocks. In this case, three types of data blocks are created as the fixed-length data blocks.

The first one is a data block having user data comprised of only data including one packet as shown in Fig. 7A. In this data block, a header is placed in front of the user data and error-correcting parity (ECC: Error Correction Code) with respect to the header and the user data is provided. The second

one is a data block having user data comprised of data including a plurality of packets (two packets in the illustrated example) as shown in Fig. 7B. In this data block, headers are respectively placed in front of the user data, and error-correcting parity with respect to the headers and user data as a whole is placed.

The third one is a data block as shown in Fig. 7C, which has user data comprised of data including one or a plurality of packets (one packet in the illustrated example) and is added with 0 data (empty data) within its space area. In this data block, a header is placed in front of the user data and error-correcting parity with respect to the header, user data and 0 data as a whole is provided.

Incidentally, when the transmission rate of the data block is given as 24.576 Mbps, the parity is made up of 8 bytes and the others are comprised of 52 bytes. Further, the data block is QPSK-modulated so as to be transferred as data having 240 symbols. On the other hand, when the transmission rate is given as 2 x 24.576 Mbps, the parity is made up of 16 bytes and the others consist of 104 bytes. Further, the data block is 16-QAM-modulated so as to be transferred as data having 240 symbols. Further, when the transmission rate is given as 4 x 24.576 Mbps, the parity is made up of 32 bytes and the others are comprised of 208 bytes. Further, the data block is 256-QAM-modulated so as to be transferred as data having 240 symbols.

Further, the header is made up of 4 bytes and has a packet ID area, a source ID area, a data-length information area, a

data-type information area, a division information area and a reserve area, as shown in Fig. 7A. For example, a 7-bit packet ID is stored in the packet ID area. In this case, the original packet is identified by using 「1」 st through 「127」 th packet ID in order. After the use of the 「127」 th packet ID, they are used again from the 「1」 st packet ID in order. A radio communication node ID (which is different from the node ID as shown in Fig.2) for a WN node corresponding to the origin of transmission is stored in the source ID area. When the wireless network is constructed of seven WN nodes at maximum, the node ID is defined as 3-bit data, for example. Incidentally, a node ID of a control node is defined as 「111」 .

Information indicative of the length of user data is stored in the data-length information area. A code indicative of whether the user data is data having an isochronous packet, data having an asynchronous packet, or data for an access·layer·command, is stored in the data-type information area. When the type of data is given as the access·layer·command, such an access·layer·command having a data format as shown in Fig. 8 is placed within the user data of a data block.

The access·layer·command is used for command communications dedicated between mutual access·layers in order to carry out communications of set information between a WN node defined as a control node and a WN node defined as a node to be controlled. Since the access·layer·command is completed between the access·layers although placed in the user data of

the data block, it does not take the packet format compliant with the IEEE1394. A command code indicates the type of access・layer・command. A payload length indicates the length of a command occupied within the user data (payload) in a byte unit. An access・layer・command is stored in a data payload. A portion stored in forward-packed form and insufficient for a quadlet (4 bytes) unit is padded with 0 data.

Referring back to Fig. 7A, the information about the division of a packet such as 「non-division」, 「top of divided packets」, 「middle of divided packets」 and 「end of divided packets」 is stored in the division information area.

As described above, the fixed-length data blocks created by the respective WN nodes are transferred through the use of a plurality of time slots provided within continuous respective cycles of 125μsec. Fig. 9 shows a radio communication data format employed in the present embodiment. Six time slots (time slots 1 through 6) are provided within each cycle. Incidentally, one of the above-described WN nodes 2 through 6 is set so as to operate as a control node as will be described later. The transmission of the respective WN nodes is controlled by the control node.

The WN node activated as the control node sends a control block antecedent to the time slots 1 through 6 within each cycle. The control block is QPSK (Quadrature Phase Shift Keying)-modulated and comprises a gap area corresponding to 6 symbols, a sink area corresponding to 11 symbols, a cycle sink area

corresponding to 7 symbols, a slot permission area corresponding to 15 symbols, and an error-correcting area corresponding to 9 symbols.

As will be described later, a controlled node performs a process for reproducing a transfer clock signal at a control node from data in the control block and synchronizing its own transfer clock signal with the reproduced transfer clock signal at the control node. Thus, the control block sent from the control node is also used as a clock-synchronizing signal.

A sink for detecting the control block is placed in the sink area. Of 32-bit cycle time data contained in a cycle·start·packet transferred to an IEEE1394 bus once per 125 μsec (isochronous cycle) by an IEEE1394 node called "cycle·master", data corresponding to the twelve lowermost bits is stored in the cycle sink area. Incidentally, an area corresponding to the remaining 2 bits (1 symbol) in the cycle sink area is reserved.

Fig. 10 shows a data format of the cycle·start·packet. In the cycle·start·packet, a header comprises an identifier (destination_ID) for a destination node, a transaction label (tl), a retry code (rt), a transaction code (tcode), priority information (pri), an identifier (source_ID) for a source node, a memory address (destination_offset) for a destination node, cycle time data and a header CRC. Fig. 11 shows a structure of 32-bit cycle time data. 7 uppermost bits indicate the number of seconds, 13 bits next to the 7 bits indicate the number of

cycles, and 12 lowermost bits indicate a count value (number of clocks) of a clock signal of 24.576 MHz, respectively.

Thus, the WN node used as the controlled node performs a process for extracting the 12-bit data thus stored in the cycle sink area of the control block and updating cycle time data generated from its own cycle time data generator according to the extracted 12-bit data. As a result, relative time intervals of all the nodes are automatically synchronized at the heads of the respective cycles.

Incidentally, the respective nodes compliant with the IEEE1394 have CSR (Control and Status Registers) defined by ISO/IEC13213. Synchronous data stored in the cycle time register therein is transmitted in a substantially 125 μsec unit, thereby implementing synchronization of the corresponding register of each node which performs isochronous transfer. As described above, the cycle time data generated from the cycle time data generator of the controlled node is updated based on the 12-bit data stored in the cycle sink area of the control block sent from the control node in each cycle of 125 μsec. It is thus possible to implement the processing, which is similar to the automatic synchronization processing of each IEEE1394 cycle time register.

Referring back to Fig. 9, 5-bit information about the time slots 1 through 6 is stored in the slot permission area. The 5-bit information comprises bits 0 through 4. When the bit 4 is given as 「1」, it indicates the transmission of a tone request

whereas when the bit 4 is given as 「0」, it indicates the transmission of data. The tone request is a request for transmitting a tone signal to control transmission power. When the bit 3 is given as 「1」, it indicates isochronous data whereas when the bit 3 is represented as 「0」, it indicates asynchronous data. The bits 2 through 0 indicate the node ID of WN nodes that permit sending, respectively. Here, the node ID of the WN node used as the control node as described above is represented as 「111」. As will be described later, the node ID intended for temporary utilization, which is used to provide an opportunity for sending, is given as 「000」 with respect to each WN node having no node ID. Thus, any of 「001」 through 「110」 is used as the node ID of a WN node used as a controlled node.

An error-correcting code with respect to the cycle sink area and slot permission area is stored in the error-correcting area. A BCH (62, 44, and 3) code is used as the error-correcting code.

Although omitted in the description of Figs. 7 A to 7C, a gap area corresponding to 6 symbols and a sink area corresponding to 2 symbols are actually added in the data block transferred using the time slots 1 through 6 in addition to a data area corresponding to 240 symbols as shown in Fig. 9. A sink for detecting the data block is placed in the sink area. Incidentally, the sink area is always QPSK-modulated regardless of a data area modulation scheme.

While the WN nodes capable of sending are specified or

designated by the respective time slots 1 through 6 in the slot permission area of the control block as described above, the designation in this case is related to the subsequent cycles, e.g., the following cycle. Fig. 12 shows an example of allocation of time slots 1 through 6. In the present example, the sending or outgoing of a WN node (control node) having a node ID = 「111」 is permitted during the time slot 1. The sending of a WN node having a node ID = 「001」 is permitted during the time slot 2. During the time slot 3, the sending of a WN node having a node ID = 「011」 is permitted. Further, the sending of a WN node having a node ID = 「101」 is permitted during the time slots 4 through 6.

A control node can control the sending of each individual WN nodes (control node and controlled node) by using the slot permission area of the control block. In this case, the control node is capable of determining nodes whose sending are permitted by the respective time slots 1 through 6, according to data transfer information of the respective WN nodes, such as a transfer width reserved by the controlled node, the state of data to be transferred, reported by the controlled node. A report about the reservation of the width of the transfer of data from the controlled node to the control node, the state of the data to be transferred, etc. is performed using the above-described access·layer·command, for example.

Thus, the control node can allocate a time slot to a predetermined WN node so as to give permission about the sending

of the reserved transfer width thereto and is capable of allocating other time slots to another WN node. Further, the control node is capable of easily managing the reservable maximum transfer width by the number of time slots to allow the transfer of ones other than the reserved transfer width. For example, data whose transfer width is not reserved and having no periodicity as in an asynchronous packet can be transferred by using time slots corresponding to a transfer width non-reserved upon transfer of an isochronous packet.

When the time slots for the non-reserved transfer width are used, the controlled node reports the situation of data to be transferred to its corresponding control node by using the above-described access·layer·command, for example. The control node calculates the distribution of the time slots corresponding to the non-reserved transfer width by using various information such as a transfer width of transfer-scheduled data obtained from the controlled node, the type of a packet therefrom, the priority of the contents, the maximum allowable transfer time, thereby determining a sending-approved node and the type of packet. It is thus possible to avoid the occurrence of a phenomenon, for example, that data is easy to remain or stay at WN nodes having lots of transfer-scheduled data, or that the transfer of data at which a transfer rate is desired, is delayed.

With respect to the data transfer using the time slots as described above, transfer processing can be changed every time

slots. For example, an isochronous transfer assures the width of transfer of data and the time required transferring it, whereas an asynchronous transfer needs to insure the transfer contents rather than the transfer time. Accordingly, transfer processes such as a process for preferentially offering an available transfer width in regard to a transfer in which priority is given to the transfer time, a process for permitting retransfer processing upon the occurrence of an error in regard to a transfer for giving priority to the assurance of the contents, can be easily implemented in time slot units by performing transfers different in priority objects on these wireless networks in separate time slots.

A configuration of a WN node 100 (corresponding to each of the WN nodes 2 through 6) will next be described. Fig. 2 shows the configuration of the WN node 100 used as a control node or a controlled node. The WN node 100 has a controller 101, which is provided with a microcomputer, for controlling the operation of the entire system. A cycle time data generator 102 for generating 32-bit cycle time data (see Fig. 11), a ROM (read only memory) 103 in which operating programs and the like for the microcomputer provided within the controller 101 are stored and a RAM (random access memory) 104 used as a working memory, are connected to the controller 101.

The cycle time data generator 102 is constructed so as to count up a clock signal of 24.576 MHz. When the WN node 100 serves as the control node, the twelve lowermost bits of the

32-bit cycle time data generated from the cycle time data generator 102 are inserted into a cycle sink area of a control block and supplied to the controlled node. On the other hand, when the WN node 100 serves as the controlled node, the cycle time data generated by the cycle time data generator 102 are updated based on the 12-bit data extracted from the cycle sink area of the received control block.

Further, the WN node 100 has a RAM 106 for temporarily storing packet data such as an isochronous packet, an asynchronous packet, sent from other IEEE1394 nodes (not shown) connected to an IEEE1394 bus 105, and a data creator 107 for utilizing the packet data stored in the RAM 106 and creating a data block (corresponding to portions of headers and user data alone, see Figs. 7A through 7C) DBL under the control of the controller 101.

When the WN node 100 serves as the control node, the data creator 107 also creates a control block (corresponding to portions of a cycle sink area and a slot permission area alone, see Fig. 9) CBL sent or transmitted at the head of each cycle of 125μsec. Further, the data creator 107 also creates an access·layer·command used for command communications dedicated between mutual access·layers to perform communications of set information between the control node and the controlled node. The access·layer·command is placed within the user data of the data block as described above and transferred.

Moreover, the WN node 100 has an error-correcting code

adder 108 for adding error-correcting parity (ECC) to the data block DBL outputted from the data creator 107, and a scramble/modulation unit 109 for effecting a scramble process and a modulating process on the output data outputted from the error-correcting code adder 108 and thereafter adding a sink to the head.

The WN node 100 includes an error-correcting code adder 110 for adding an error-correcting code to the control block CBL outputted from the data creator 107, a scramble/modulation unit 111 for effecting a scramble process and a modulating process on the output data outputted from the error-correcting code adder 110 and thereafter adding a sink to the head, and a light-emitting device (light-emitting diode) 112 for outputting an infrared-ray signal corresponding to each of modulated signals outputted from the scramble/modulation units 109 and 111. Since the control block CBL is not created by the data creator 107 when the WN node 100 is now given as the controlled node, the error-correcting code adder 110 and the scramble/modulation unit 111 are not used.

The WN node 100 has a light-receiving device (photo diode) 115 for receiving the infrared-ray signal, and a sink detection·clock reproducer 116 for pattern-detecting a sink of a data block (see Fig. 9) from a signal outputted from the light-receiving device 115, outputting a detection timing signal SYd and generating a clock signal CKd synchronized with the data block whose sink is detected. The clock signal CKd is used upon processing the data block whose sink has been detected.

The WN node 100 has a demodulation/de-scramble unit 117 for performing a demodulating process and a de-scrambling process on the data block whose sink has been detected, based on the detection timing signal SYd, an error corrector 118 for using parity for the data block outputted from the demodulation/de-scramble unit 117 to error-correct portions of a header and user data, a user data extractor 119 for extracting user data from the data block DBL outputted from the error corrector 118, and a header extractor 120 for extracting a header added to the user data from the data block DBL. The header extracted by the header extractor 120 is supplied to the controller 101.

The WN node 100 includes a RAM 121 for temporarily storing the user data extracted from the user data extractor 119, and a data restorer 122 for restoring the packet data, based on header information while using the user data stored in the RAM 121 and transmitting it to the IEEE1394 node electrically connected to the bus 105. Incidentally, when the user data is an access·layer·command, the command is transmitted to the controller 101 through the data restorer 122.

The WN node 100 includes a sink detection·clock reproducer 125 for pattern-detecting a sink of a control block (see Fig. 9) from the signal outputted from the light-receiving device 115, outputting a detection timing signal SYc and generating a clock signal CKc synchronized with the control block whose sink is detected. Here, the clock signal CKc is used upon processing

the control block whose sink has been detected, and is used as a transfer clock signal for sending or outgoing processing.

The WN node 100 has a demodulation/de-scramble unit 126 for performing a demodulating process and a de-scrambling process on the control block whose sink has been detected, based on the detection timing signal SYc, and an error corrector 127 for using an error-correcting code for the output data outputted from the demodulation/de-scramble unit 126 to error-correct the control block (corresponding to a cycle sink area and a slot permission area) CBL and supplying it to the controller 101.

When the WN node 100 serves as the control node, the demodulation/de-scramble unit 126 and the error corrector 127 are not used. On the other hand, when the WN node 100 serves as the control node, the sink detection·clock reproducer 125 does not perform a synchronous process by reference to the clock signal reproduced from the control block and simply serves as a unit for generating a freerunning transfer clock signal.

The operation of the WN node (wireless network node) 100 shown in Fig. 2 will next be described.

A description will first be made of a case where the WN node 100 is of a control node. A sending operation thereof is performed as follows:

Under the control of the controller 101, the data creator 107 creates a control block CBL (see Fig. 9) at the head of each cycle of 125μsec. Thereafter, the error-correcting code adder 110 adds an error-correcting code to the control block CBL.

Further, the scramble/modulation unit 111 effects a scramble process and a modulating process on the control block CBL and thereafter adds a sink thereto, thereby forming a sending signal for the control block. The light-emitting device 112 is driven by the signal, so that the control block is outputted from the light-emitting device 112 as an infrared-ray signal.

When packet data such as an isochronous packet, an asynchronous packet is transmitted from the IEEE1394 node to the data creator 107 through the bus 105, the packet data is temporarily stored in the RAM 106. Under the control of the controller 101, the data creator 107 creates each data block DBL (see Figs. 7A through 7C) from the packet data stored in the RAM 106.

The data creator 107 outputs a respective one data block DBL with timing of each time slot at which its own sending is allowed. The error-correcting code adder 108 adds an error-correcting code to the data block DBL. Further, the scramble/modulation unit 109 performs a scramble process and a modulating process on the data block and thereafter adds a sink thereto, thereby forming a sending signal for the data block. The light-emitting device 112 is driven by the signal, whereby the data block is outputted from the light-emitting device 112 as an infrared-ray signal.

A receiving operation is performed as follows. The light-receiving device 115 receives the infrared-ray signal for the data block. An output signal outputted from the light-

detecting device 115 is supplied to the sink detection·clock reproducer 116 where the sink of the data block is detected, whereby a detection timing signal SYd is obtained and a clock signal CKd synchronized with the data block whose sink has been detected, is generated.

Further, the output signal of the light-detecting device 115 is supplied to the demodulation/de-scramble unit 117 where a demodulating process and a de-scramble process are effected on the signal, based on the detecting timing signal SYd. Further, the output data outputted from the demodulation/de-scramble unit 117 is supplied to the error corrector 118 where the data block DBL is error-corrected using an error-correcting code.

The data block DBL outputted from the error corrector 118 is supplied to the header extractor 120 where the corresponding header is extracted, followed by supplying said header to the controller 101. Similarly, the data block DBL outputted from the error corrector 118 is supplied to the user data extractor 119 from which the user data thereof is supplied to the data restorer 122. The data restorer reconstructs packet data from the extracted user data under the control of the controller 101 based on information about the header. The reconstructed packet data is sent to the IEEE1394 node through the bus 105.

A description will be further made of a case where the WN node 100 is of a controlled node. Its sending operation is carried out as follows.

When packet data such as an isochronous packet, an

asynchronous packet is transmitted from the IEEE1394 node to the data creator 107 through the bus 105, the packet data is temporarily stored in the RAM 106. Under the control of the controller 101, the data creator 107 creates each data block DBL (see Figs. 7A through 7C) from the packet data stored in the RAM 106.

The data creator 107 outputs a respective one data block DBL with timing of each time slot at which its own sending is allowed. The error-correcting code adder 108 adds an error-correcting code to the data block DBL. Further, the scramble/modulation unit 109 performs a scramble process and a modulating process on the data block and thereafter adds a sink thereto, thereby forming a sending signal for the data block. The light-emitting device 112 is driven by the signal, whereby the data block is outputted from the light-emitting device 112 as an infrared-ray signal.

A receiving operation is performed as follows. The light-detecting device 115 receives infrared-ray signals for a control block and a data block. An output signal outputted from the light-detecting device 115 is supplied to the sink detection·clock reproducer 125 where the sink of the control block is detected, whereby a detection timing signal SYc is obtained and a clock signal CKc synchronized with the control block whose sink has been detected, is generated. As described above, the clock signal CKc is used to process the control block and used as a transfer clock signal. That is, the sending

operation referred to above is executed in synchronism with the transfer clock signal.

Further, the output signal of the light-detecting device 115 is supplied to the demodulation/de-scramble unit 126 where a demodulating process and a de-scramble process are effected on the signal, based on the detecting timing signal SYc. Further, the data outputted from the demodulation/de-scramble unit 126 is supplied to the error corrector 127 where the control block CBL is error-corrected using an error-correcting code.

The control block CBL outputted from the error corrector 127 is supplied to the controller 101. The controller 101 extracts 12-bit data contained in a cycle sink area of the control block CBL and updates cycle time data generated from the cycle time data generator 102, based on the 12-bit data. Thus, relative time intervals of all the nodes are automatically synchronized at the heads of the respective cycles. Further, the controller 101 can recognize each time slot at which its own sending is allowed, from information in the slot permission area of the control block CBL.

Further, the output signal of the light-receiving device 115 is supplied to the sink detection·clock reproducer 116 where the sink of the data block is detected, whereby a detection timing signal SYd is obtained and a clock signal CKd synchronized with the data block whose sink has been detected, is generated.

The output signal of the light-receiving device 115 is supplied to the demodulation/de-scramble unit 117 where a

demodulating process and a de-scrambling process are effected on the signal, based on the detection timing signal SYd. Further, the output data outputted from the demodulation/de-scramble unit 117 is supplied to the error corrector 118 where the data block DBL is error-corrected by using an error-correcting code.

The data block DBL outputted from the error corrector 118 is supplied to the header extractor 120 where the corresponding header is extracted, followed by supplying said header to the controller 101. Similarly, the data block DBL outputted from the error corrector 118 is supplied to the user data extractor 119 from which the user data thereof is supplied to the data restorer 122. The data restorer reconstructs packet data from the extracted user data under the control of the controller 101 based on information about the header. The reconstructed packet data is sent to the IEEE1394 node through the bus 105.

A description will next be made of an operation example at the time that packet data compliant with the IEEE1394 Standard is transferred from a first WN node to a second WN node, by using Figs. 13A through 13E.

Now consider where after a cycle·start·packet (CS) has been transmitted from an IEEE1394 node to a data creator 107 of the first WN node as shown in Fig. 13A, a packet A and a packet B are transmitted as packet data. Incidentally, the cycle·start·packet is transmitted once per 125μsec from a cycle·master. However, it is not necessarily transmitted at 125 μsec time interval. The time interval might be greater than

125μsec according to the size of the packet data.

The data creator 107 creates fixed-length data blocks from these packets A and B as shown in Fig. 13B. In this case, for example, a data block having only data in the packet A, a data block having data in the packets A and B, a data block having only data in the packet B and in which 0 data is placed in a space area, etc. are created according to data lengths of the packets A and B. In this case, headers respectively having information about the original packets, divided information, etc. are provided at the heads of data (user data) constituting the respective packets.

Thus, the corresponding data block created by the data creator 107 of the first WN node is sent to the second WN node through the use of time slots 1 through 3 at which sending thereof is allowed by a WN node used as a control node as shown in Fig. 13C. In this case, error-correcting parity is added to each data block and subjected to a scramble process and a modulating process, after which a sink is added to each data block, which in turn is transmitted as an infrared-ray signal.

As shown in Fig. 13D, the second WN node receives each data block sent from the first WN node. User data extracted from the data block is supplied to a data restorer 122. Further, the header extracted from the data block is supplied to a controller 101. The data restorer 122 reconstructs the original packet data from the user data as shown in Fig. 13E, based on the information about the original packets, the divided information, etc.

contained in the headers. The packet data is transmitted to the IEEE1394 node.

A description will next be made of how to enter into and remove from the wireless network shown in Fig. 1 and how to allocate node ID for radio communication to the respective WN nodes in the wireless network.

In the present embodiment, a wireless network having seven WN nodes at maximum can be constructed. The radio communication node ID comprises 3-bit data. As described above, 「111」 is defined as a node ID for each control node, 「000」 is defined as a node ID for the purpose of temporary utilization, and a node ID for each controlled node is defined as any of 「001」 through 「110」. The allocation of the node ID to the controlled nodes is collectively managed by the control node.

Therefore, the RAM 104 of the WN node 100 (see Fig. 2) capable of serving as the control node is provided with a first storage area for storing therein a use flag indicative of the condition of the usage of node ID, a second storage area for storing therein information about the frequency of sending of the WN node having the node ID, a third storage area for storing therein the a count of monitoring counter relating to the WN node having its node ID and forth storage area for storing therein a count of delaying counter relating to the WN node having its node, as shown in Fig. 14, said monitoring and delaying counters being respectively described later.

A node ID at which the use flag is 「1」, indicates that

it is in use, and a node ID at which the use flag is 「0」, indicates its non-use. Further, the frequent information is set as 2-bit data. 「11」 indicates high frequency, 「10」 indicates normal frequency, and 「00」 indicates low frequency, respectively. Incidentally, the frequency with respect to each non-used node ID is set to 「00」.

A node initializing process will next be explained using a flowchart shown in Fig. 15. A control program for the node initializing process is started up with power-on, for example.

When the node initializing process is started up, the WN node 100 starts to receive a signal from another WN node in Step S51. It is determined in Step S52 whether it can receive a control block from a WN node 100 used as a control node.

When it is found that the control block cannot be received, this means that the wireless network is not yet constructed. Therefore, the WN node determines in Step S53 whether it itself is able to serve as the control node. Here, RAM104 of the WN node 100 capable of serving as the control node, is provided with the first storage area for storing therein the use flag indicative of the condition of the usage of node ID, and the second storage area for storing therein the information about the frequency of sending of the WN node having the node ID as well as the third and forth storage areas for storing the counts of the monitoring and delaying counters, respectively. When the WN node is found to be unable to serve as the control node, the control program is returned to Step S51. On the other hand, when

the WN node is found to be able to serve as the control node, it proceeds to Step S54 where it serves as the control node, whereby the WN node is shifted to a control node processing state.

In this case, the WN node 100, which has just taken on the control node, has no controlled nodes which serve as objects for communications in the corresponding wireless network. Therefore, the WN node serving as the control node continues to send the control block at 125 μsec intervals, for example. Owing to the sending of the control block, another WN node 100 is prevented from serving as the control node within the corresponding wireless space.

When it is determined in Step S52 that a signal from the WN node 100 used as the control node, e.g., a control block can be received, the WN node proceeds to Step S55 to enter into the corresponding wireless network as the controlled node. In the slot permission area of the control block (see Fig. 9) as described above, the WN node 100 capable of sending with each individual time slots 1 to 6 in the next cycle is designated or specified through the use of the node ID. By using the node ID 「000」 for the purpose of the temporary utilization, a sending's opportunity is given to a WN node 100 having no node ID.

In Step S55, the WN node 100 makes a request to a control node for transmission of the use condition of the node ID for radio communication by using a time slot designated by the node ID 「000」. This request is performed using an access·layer·command. When the request is made, the WN node 100

used as the control node refers to the use flags stored in the first storage area of the RAM 104 and transmits the use condition of the ID to the requested new node. The transmission of the use condition is also performed using the access·layer·command.

It is next determined based on the use condition of the node ID in Step S56 whether non-used node ID exists. When the no-used node ID is absent, the control program proceeds to Step S57 where a process for entering controlled nodes into the wireless network is stopped. It is thus not possible to enter controlled nodes exceeding six into the wireless network.

When the non-used node ID is found to exist in Step S56, the control program proceeds to Step S58 where its own used node ID is determined. In Step S59, the WN node requests the WN node 100 used as the control node to update the respective use flags corresponding to the determined node ID from 「0」 to 「1」 through the use of the time slot designated by the above-described node ID「000」. This request is performed by using the access·layer·command.

When the request is made, the WN node 100 used as the control node renews the use flag of the node ID, whose updating has been requested as described above, among the use flags stored in the first storage area of the RAM 104 from「0」to「1」. When the use flag of the requested node ID, whose updating has been requested, is already renewed to 「1」, there is a high possibility that while the corresponding new node is performing processing, the use flag for the corresponding ID would be updated to「1」

by a request issued from another new node, thereby resulting in a failure in renewal. The WN node 100 used as the control node notifies a success or failure in renewal to the new node to which the renewal of the use flag of the corresponding node ID is requested. This notification is also performed by the access·layer·command.

It is next determined in Step S60 whether the use flag has succeeded in its renewal. When the renewal is founded to have failed, the control program is returned to Step S55 where the WN node requests the control node to transmit the use condition of the node ID again in order to enter into the corresponding wireless network as a controlled node. Therefore, the operation similar to above is repeated. On the other hand, when the renewal is found to have succeeded, the WN node is brought to a controlled node specified by the corresponding node ID and shifts to a controlled node processing state in Step S61. In this case, the control node allocates the node ID for radio communication corresponding thereto to the controlled node.

Owing to the above node initializing process, the new node automatically obtains the node ID for radio communication and enters into the corresponding wireless network, based on the so-obtained node ID. As a result thereof, this controlled node can be communicated by radio using allocated node ID.

A description will next be made of a node ID deallocating processes at the time that a WN node 100 used as a controlled node is removed from the corresponding wireless network, with

reference to a flowchart shown in Fig. 16. A control program for the node ID deallocating processes is started up with power-off, for example.

When the node ID deallocating processes are started, the WN node 100 makes a request to a control node for the transmission of the use condition of the node ID through the use of a time slot designated by its own node ID in Step S71. When the request is made, the WN node used as the control node refers to the use flags corresponding to the node ID stored in the first storage area of the RAM 104 and transmits the use condition of the node ID to the requested node.

Next, in Step S72, the WN node confirms that its own node ID is in use, according to the use condition of the node ID. In Step S73, the WN node requests the WN node 100 used as the control node to update the respective use flags corresponding to its own node ID from 「1」 to 「0」 through the use of the time slot specified by its own node ID. In Step S74, the node ID deallocating process terminates.

When the above request is made, the WN node 100 used as the control node rewrites the renewal-requested use flag corresponding to the requested node ID as described above, among the use flags stored in the first storage area of the RAM 104, from 「1」 to 「0」. Therefore, the control node deallocates the node ID for radio communication allocated to the controlled node.

Owing to the above-described node ID deallocating process, each controlled node having the node ID for radio communication

automatically deallocates its node ID and is hence removed from the corresponding wireless network.

As described above, the control program (see Fig. 15) for the node initializing process is started up when the WN node 100 is power-on. On the other hand, the control program (see Fig. 16) for the node ID deallocating process is started up when the WN node 100 is power-off. Therefore, the corresponding wireless network continues to exist unless the power of the control node is turned off. Other nodes obtain their node ID for radio communication with power-on and can enter into the corresponding wireless network as controlled nodes. With power-off in reverse, the nodes deallocate their node ID for radio communication, so that they can be removed from the corresponding wireless network.

Meanwhile, communications between a control node and a controlled node are considered to lose contact with each other when a WN node 100 constructing a wireless network is moved outward from the network and a signal is cut off or screened even when it is placed within the network. Even in such a case, the network cannot be operated with efficiency even though the control node gives permission of sending to the corresponding controlled node in a manner similar to other controlled nodes. Therefore, the WN node 100 used as the control node executes a process for monitoring a situation of communication.

A description will be made of a process for monitoring the situation of communication at the WN node 100 used as the control node by using a flowchart shown in Fig. 17. A control

program for the monitoring process is started up, for example, every 125 μsec as a cycle unit.

First, the minimum value of node ID for radio communication is given as "n" in Step S75. Next, it is determined in Step S76 whether the node ID corresponding to the "n" is in use. When it is not in use, the process proceeds to Step S77 where it is determined that the "n" corresponds to the final node ID. When the "n" is found not to be the final node ID, a subsequent large node ID is set to "n" in Step S78 and then, the process is returned to Step S76. On the other hand, when the "n" is found to be the final node ID, the process proceeds to Step S79 where the monitoring process is complete.

When the node ID corresponding to the "n" is in use in Step S76, it is studied in Step S82 to determine whether a signal is normally received from the node (hereinafter called [node (n)]) having the node ID corresponding to the "n". Namely, it is determined whether a time slot permitted the sending after the former monitoring process has been carried out exists and a signal sending from the node (n) is normally received using this time slot.

Next, a result of the above study is determined in Step S83. When the signal is found not to be received normally from the node (n), the process proceeds to Step S84 where a count of monitoring counter stored in the third storage area of RAM 104 (see Fig. 14) is incremented by 1. In Step S85, it is determined whether the frequency of sending permission to the node (n) is

set to low frequency. In other words, it is determined whether frequency information corresponding to the node (n) stored in the second storage area (see Fig. 14) of the RAM 104 is given as 「00」.

When the frequency of sending permission to the node (n) is found not to be low frequency, it is determined in Step S86 whether the count of the monitoring counter is a default value, i.e., the number of decision that it is not normally received reaches a predetermined number of times. When the count of monitoring counter is found not to be the default value, the process proceeds to Step S77. On the other hand, when the count of monitoring counter is found to be the default, the process proceeds to Step S87 where the frequency information of the node (n) stored in the second storage area of the RAM 104 is renewed to 「00」 and the frequency of sending permission to the node (n) is set to the low frequency. Further, the count of the monitoring counter of the node (n) is cleared to 0 in Step S88 and then, the process proceeds to Step S77. Owing to the setting of the sending frequency for the node (n) to the low frequency as described above, the frequency of sending permission to the node (n) becomes low as will be described later and the opportunities of sending permission to other nodes are enlarged, thereby allowing efficient operation of the wireless network.

When the frequency of sending is found to be set to the low frequency in Step S85, the process proceeds to Step S95 where it is determined whether the count of the monitoring counter is

a default value. When the count of monitoring counter is found not to be the default value, the process proceeds to Step S77. On the other hand, when the count of monitoring counter is found to be the default value, the process proceeds to Step S96 where a node ID corresponding to the node (n) is forcefully deallocated and the process goes to a delaying process. Then, in Step S97, the count of the monitoring counter of the node (n) is cleared to 0 and thereafter the process proceeds to Step S77.

The forceful deallocation of the node ID as described above makes it possible to eliminate a waste such that the node ID and the transfer width continues to be offered to each node expected to be already unusable. Further, in the delaying process as described above, a use flag of the node ID corresponding to "n" stored in the first storage area of RAM 104 (see Fig. 14) is maintained as 「1」 and the node ID corresponding to "n" is not allocated to a controlled node newly entered into the network while it is treated as being unallocated in a process for determining a sending permission node as described later.

This situation of the delaying process is released by control operation of delaying process, as described later, after a predetermined period of time has passed and then, the use flag is changed from 「1」 to 「0」 so that the node ID corresponding to "n" is allocated to a controlled node newly entered into the network. Thus, the reason why the node ID corresponding to "n" is allocated after a predetermined period of time has passed is that it is conceivable that a count of the monitoring counter

of controlled node (as described later) is not yet reached to the default value when the control node forcefully deallocates the node ID of the corresponding controlled node if a communication from the control node to the controlled node is reached to some extent while a communication from the controlled node to the control node is not perfectly reached. This is also because the controlled node does not deallocate the node ID thereof but maintains it, in such a case.

In this condition, if the control node allocates the node ID corresponding to "n" that the control node forcefully deallocates to another controlled node newly entered into the network, two different controlled nodes having the same node ID exist in one network to impair a stability of communication. In order to stay out of such a trouble, the forcefully deallocated node ID corresponding to "n" may be allocated to another controlled node after a predetermined period of time has passed, as described above.

When it is determined in Step S83 that the signal is found to be received normally from the node (n), the process proceeds to Step S90 where the count of the monitoring counter of the node (n) is cleared to 0. It is determined in Step S91 whether a request for a return to the normal frequency is made from the node (n). This return request is transmitted by the above-described access·layer·command. When the request for the return to the normal frequency is given, the process proceeds to Step S92 where the frequency of sending permission is set to

the normal frequency. In other words, the frequency information about the node (n) stored in the second storage area of the RAM 104 is renewed from「00」to「10」. Thereafter, the process proceeds to Step S77.

When the request for the return to the normal frequency is found not to be issued from the node (n) in Step S91, the process proceeds to Step S93 where it is determined whether a request to high frequency is issued from the node (n). This request is also transmitted through the use of the above-described access·layer·command. When the request to the high frequency is not made, the process proceeds to Step S77. On the other hand, when the request to the high frequency is made, the process proceeds to Step S94 where the frequency of sending permission is set to the high frequency. In other words, the frequency information about the node (n) stored in the second storage area of the RAM 104 is renewed to「11」. Thereafter, the process proceeds to Step S77.

Incidentally, as described above, the control node prepares a node ID for the purpose of temporary utilization to give a sending opportunity to a node with no node ID. The control node can provide the permission of sending by the node ID for the purpose of temporary utilization in a cycle for the corresponding node set to the low frequency, for example. Alternatively, the control node can provide the permission of sending by the node ID for the purpose of temporary utilization by utilizing that there is no data to be sent to other nodes and

allowance is made for a data transfer width. This is because a node desiring to enter into the corresponding wireless network does not necessarily exist within the network at all times.

The sending permission to the respective WN nodes 100 is limited according to the frequency of sending permission to the respective nodes adjusted by the above-described monitoring process (see Fig. 17) of situation of communication. Fig. 18 shows an example of a control operation of WN node 100 used as a control node, for determining a node that permits sending in a given time slot.

The example shown in Fig. 18 illustrates a case in which a wireless network is constructed by seven WN nodes 100 at maximum inclusive of a control node. When, in this case, the frequency of sending permission to a certain WN node 100 is set to normal frequency, a decision as to sending permission with respect to one time slot is made to the WN node 100 within one cycle used for a sending permission process. Here, a process for determining whether the sending permission should be given to all the WN nodes 100 in order is performed during one cycle for the sending permission process.

On the other hand, when the frequency of sending permission to the certain WN node 100 is set to high frequency, a decision as to sending permission with respect to continuous three time slots is made to the WN node 100 within one cycle for the sending permission process. Further, when the frequency of sending permission to the certain WN node 100 is set to low

frequency, a decision as to sending permission with respect to one time slot is made to the WN node 100 within 32 cycles for the sending permission process.

It is first determined in Step S101 whether a count N of an ID counter is greater than 6. In this case, 0 through 6 each represented as the count N correspond to 「001」 through 「111」 of nodes ID, respectively. When the count N is found not to be N > 6, this means that the control operation is in course of one cycle for the sending permission process, and the operation goes to Step S102 where a decision is made as to whether a node ID corresponding to the count N is in use. When the node ID is found to be not in use, the operation goes to Step 109 where the count N of the ID counter is incremented, followed by return to Step S101. On the other hand, when the node ID is found to be in use, it is determined in Step S103 whether the frequency of sending permission to a WN node having the node ID is set to low frequency.

When the frequency of sending permission is not set to the low frequency, the operation goes to Step S104. On the other hand, when the frequency of sending permission is set to the low frequency, the operation goes to Step S112 where it is determined whether a count M of a low-frequency counter is 0. If the count M is found not to be M = 0, the operation goes to Step 109 where the count N of the ID counter is incremented, followed by return to Step S101. On the other hand, when M = 0, the operation goes to Step S104. In Step S104, the permission of sending by a node ID corresponding to the count N of the ID counter is decided so

as to be made to one time slot for the corresponding process.

It is determined in Step S105 whether the frequency of sending permission to a WN node 100 having the node ID is set to high frequency. When the answer is found not to be high frequency, the operation goes to Step S106 where a count L of a high-frequency counter is set to 0. In Step S107, the count of the ID counter is incremented. Thereafter, the operation goes to Step S108 where the process for determining each sending-permitted node with respect to one time slot terminates.

On the other hand, when it is determined in Step S105 that the frequency of sending permission is set to the high frequency, the operation goes to Step S110 where the count L of the high-frequency counter is incremented, followed by proceeding to Step S111. It is determined in Step S111 whether the count L is greater than 2. If the count L is found not to be L > 2, then the operation goes to Step 108 where the process for determining the sending permission node terminates. On the other hand, when L > 2, the operation goes to Step S106 where the count L of the high-frequency counter is set to 0. In Step S107, the count of the ID counter is incremented. Thereafter, the operation goes to Step S108 where the process for deciding the sending permission node with respect to one time slot terminates.

When N > 6 in Step S101, this means that one cycle for the sending permission process has been finished. Therefore, the operation goes to Step S113 where the count N of the ID counter

is set to 0. In Step S114, the count M of the low-frequency counter is incremented. It is determined in Step S115 whether the count M is greater than 31. If the count M is found not to be M > 31, this means that the operation is in course of 32 cycles for the sending permission process, and the operation goes to Step S102 where operation similar to the above operation is performed. On the other hand, when M > 31, this means that the above 32 cycles have been finished, and the count M is set to 0. Thereafter, the operation goes to Steps S102.

When the WN node 100 having the radio communication ID corresponding to the count N of the ID counter is in use and the frequency of its sending permission is set to the normal frequency upon the control operation shown in Fig. 18, the control operation routine goes from Step S102 to Step S104 through Step S103, where the permission of sending by the above-described node ID is decided so as to be made to one time slot for the corresponding process. Further, the operation goes to Step S107 through Step S106, where the count N is incremented and thereafter the corresponding process terminates. Thus, a decision as to the sending permission is inevitably made to the WN node 100 whose frequency of sending permission is set to the normal frequency upon the control operation shown in Fig. 18. Accordingly, the decision as to the sending permission with respect to one time slot is made to the WN node 100 within one cycle for the sending permission process.

Next, when the WN node 100 having the node ID corresponding

to the count N of the ID counter is in use and the frequency of its sending permission is set to the high frequency, the operation goes from Step S102 to Step 104 through Step S103, where the permission of sending by the above-described node ID is decided so as to be made to one time slot for the corresponding process. In Step S110, the count L of the high-frequency counter is incremented. When the count L is not greater than 2, the count N of the ID counter is not incremented and the corresponding process terminates.

Therefore, the operation shown in Fig. 18 is continuously performed three times with respect to the WN node 100 whose frequency of sending permission is set to the high frequency, with the node ID of the corresponding WN node 100 as an object, thereby to make a decision as to the sending permission to continuous three time slots. Accordingly, the decision as to the sending permission with respect to the continuous three time slots is made to the WN node 100 within one cycle for the sending permission process.

Next, when the WN node 100 having the node ID corresponding to the count N of the ID counter is in use and the frequency of its sending permission is set to the low frequency, the operation goes from Step S102 to Step S112 through Step S103. Only when the count M of the low-frequency counter is 0, the operation goes to Step S104 where the permission of sending by the above-described node ID is decided so as to be made to one time slot for the corresponding process. Further, the operation goes to

Step S107 through Step S106, where the count N is incremented and the processing terminates.

Since the count M of the low-frequency counter is set to 0 every time 32 cycles for the sending permission process are completed (Steps S115 and S116), a decision as to the sending permission is made to the WN node 100 whose frequency of sending permission is set to the low frequency, only in the first cycle of the 32 cycles for the sending permission process. Thus, when the frequency of sending permission to the WN node 100 is set to the low frequency, a decision as to the sending permission with respect to one time slot is made to the WN node 100 within the 32 cycles for the sending permission process.

A description will be made of a process for monitoring the situation of communication at the controlled node by using a flowchart shown in Fig. 19. A control program for the monitoring process is started up, for example, every 125 μsec as a cycle unit.

First, a sending permission signal from the control node is studied in Sep S121. Namely, it is determined whether or not the sending permission signal is normally received from the control node after the monitoring process has been formerly carried out. A result of the study is determined in Step S122. When the sending permission signal is found to be normally received from the control node, the process proceeds to Step S126 where a count of the monitoring counter is cleared to 0 and then, the process proceeds to Step S127 where the monitoring process

of a situation of communication is complete.

On the other hand, when the sending permission signal is found not to be normally received from the control node in Step S122, the process proceeds to Step S123. In the step S123, a count of the monitoring counter is incremented by 1. The process proceeds to Step S124 where it is determined whether a count of the monitor counter is a default value. When it is found not to be a default value, the process proceeds to Step S127 where the monitoring process of a situation of communication is complete.

On the other hand, when it is found to be a default value, this means that the corresponding controlled node has not normally received the sending permission signal from the control node for a long time. It is also conceivable that the node ID allocated to the controlled node has been already deallocated forcefully in the control side. In such a case, since the controlled node may not communicate the control node if the controlled node keeps having the allocated node ID, the node ID is cleared and deallocated in Step S125. Thereafter, the process proceeds to Step S127 where the monitoring process of a situation of communication is complete. The controlled node is required to perform the node initializing process (see Fig. 15) again in order to enter into the network once more after the node ID corresponding to the controlled node has been deallocated.

The default values of monitoring counters in the control and controlled nodes becomes a factor that the controlled node is deviated from the network at ease in respect of the situation

of communication. Therefore, if these default values are set to small ones, the controlled node is deviated from the network at ease and thus, this causes a poor stability of communication path of the network but is suitable for a network attaching much importance to a communication efficiency. If these default values are set to large ones, the controlled node is hard to deviated from the corresponding network and thus, this causes a good stability of communication path of the network but makes it difficult to improve a communication efficiency suitably in case of a poor situation of communication. In consideration of these conditions, the default values of monitoring counters in the control and controlled nodes may be set.

A description will be made of a delaying process in the control node for allocating the described-above deallocated node ID corresponding to "n" (see Step S96 in Fig. 17) to a controlled node newly entered into the network by using a flowchart shown in Fig. 20. A control program for the delaying process is started up, for example, every 125 μsec as a cycle unit.

First, the minimum value of node ID is given as "n" in Step S131. Next, it is determined in Step S132 whether the node ID corresponding to the "n" is in use for the delaying process. When it is found not to be in use for the delaying process, the process proceeds to Step S137 where it is determined that the "n" corresponds to the final node ID. When the "n" is found not to be the final node ID, a subsequent large node ID is set to "n" in Step S138 and then, the process is returned to Step S132.

On the other hand, when the "n" is found to be the final node ID, the process proceeds to Step S139 where the delaying process is complete.

On the other hand, when the node ID corresponding to "n" is found to be in used for the delaying process in Step S132, the process proceeds to Step S133 where a count of the delaying counter of node (n) stored in forth storage area of RAM 104 (see Fig. 14) is incremented by 1. The process proceeds to Step S134 where it is determined whether a count of the delaying counter is a default value. Here, the default value of the delaying counter is set to a value larger than the described-above default value of the monitoring counter of the controlled node. This is because, if it is set to smaller one, the delaying process of control node may be terminated before deallocating process (a process in Step S125 as shown in Fig. 19) of the node ID that the controlled node holds has been complete. In this case, two different controlled node having the same node ID may exist in one network. This causes the delaying process that is carried out for avoiding the above case to count for nothing.

When it is found not to be a default value in Step S134, the process proceeds to Step S137. On the other hand, when it is found to be a default value, the process proceeds to Step S135. In Step S135, restriction on use of the node ID corresponding to "n" is lifted. Namely, the use flag of the node ID corresponding to "n" stored in the first storage area of RAM 104 is changed from 「1」 to 「0」 so that the node ID corresponding to "n" may

be allocated to a controlled node newly entered into the network. A count of the delaying counter in the node ID is cleared to 0 in Step S136. Thereafter, the process proceeds to Step S137.

According to this delaying process, the forcefully deallocated node ID corresponding to "n" may be allocated to a controlled node newly entered into the network after a predetermined period of time has passed. This prevents a node ID from being in possession of a plurality of controlled nodes, thereby avoiding an occurrence of an interference condition. Since the described-above monitoring process of the situation of communication is a factor that makes an efficiency of network changed, it prefers to perform the process at very close intervals. In the IEEE 1394 system described above, for example, it is desirable that the monitoring process is started up every 125 μsec as a cycle unit. If an error occurs at random in the network, it is desirable that default values of the control and controlled nodes are set to the same ones because probabilities in clearance of monitoring counters carried out in the control and controlled nodes are the same.

As described above, since the node ID is deallocated when the counts of the monitoring counters, which are equipped for respective control and controlled nodes, reach to the default values, it is possible to control a communication so as to implement a waste-free communication, thereby improving an efficiency of communication.

Computer program carrying out the above processes may be

offered to a user by way of a recording medium such as magnetic disk and CD-ROM as well as by transmitting it to the user through a network, for example, internet, digital satellite or the like and then, recording it on the recording medium such as hard disk or memory.

In the aforementioned embodiments as well, the present invention is applied to the wireless network for transferring the packet data such as the isochronous packet, the asynchronous packet, etc. based on the IEEE1394. However, the present invention can be similarly applied even to a wireless network for transferring data on other high-speed serial buses such as a USB (Universal Serial Bus), etc.

Further, in the aforementioned embodiments, the present invention is applied to the wireless network using the infrared rays as the radio communication medium. However, the present invention can be similarly applied even to a wireless network using other radio communication mediums such as radio waves, laser light, etc.

According to this invention, the control device determines whether the controlled apparatus is normally controlled corresponding to a signal such as a sending permission signal, from the control device, measures a duration of abnormally controlled period of time and deallocates an identifier allocated to the controlled apparatus when the measured duration exceeds a predetermined period of time (first time). Further, according to this invention, the controlled

apparatus (an information processing apparatus) determines whether it is normally controlled corresponding to a signal from the control device, measures a duration of abnormally controlled period of time, and deallocates an identifier allocated thereto from the control device when the duration exceeds a predetermined period of time (second time). Thereby, it is possible to eliminate from the network the portable devices in poor communication condition, thereby avoiding the waste communication and improving the efficiency of communication.

Further, according to this invention, the control device allows the deallocated identifier to be allocated to any of the pieces of controlled apparatus after a predetermined period of time (third time) has elapsed. In this case, a setting such that the third time is set as being longer than the second time allows the identifier deallocated by the control device to be allocated to any of the pieces of controlled apparatus after it has been deallocated from a controlled apparatus thus already allocated. Thereby, this avoids failing to allocate the same identifier to the pieces of controlled apparatus in duplicate and enables the communication stability to be maintained.

INDUSTRIAL APPLICABILITY

As described above, the control device, the control method, the information processing apparatus, the information processing method, the communication system, and computer-readable medium according to the present invention are suitable

for application to the wireless network using radio communication mediums such as infrared rays.

CLAIMS

1. A control device for controlling pieces of controlled apparatus performing communications within a network, comprising:

a determining means for determining whether said controlled apparatus is normally controlled corresponding to a signal from said control device;

a measuring means for measuring a duration of abnormally controlled period of time when said determining means determines that said controlled apparatus is abnormally controlled corresponding to a signal from said control device; and

a deallocating means for deallocating an identifier allocated to said controlled apparatus for identifying said controlled apparatus when said duration measured by said measuring means exceeds a predetermined period of time.

2. The control device according to claim 1, characterized in that the signal from said control device is a sending permission signal to said controlled apparatus.

3. The control device according to claim 1, characterized in that the control device further comprises a use-restriction-lifting means for lifting a use restriction on the controlled apparatus to allow the identifier deallocated by the deallocating means to be allocated to any of said pieces of

controlled apparatus after a predetermined period of time has elapsed.

4. The control device according to claim 3, characterized in that said control device further comprises a storage means for storing data indicating a use condition of said identifier, and that said use-restriction-lifting mans changes said data indicating a use condition of said identifier, said data being stored in said storage means, to data indicating unallocated condition when said deallocated identifier is allocated to any of said pieces of controlled apparatus.

5. The control device according to claim 1, characterized in that said determining means carries out said determination every given cycle; and

that said measuring means is provided with a counter for measuring said duration and when said controlled apparatus is found to be abnormally controlled corresponding to the signal from the control device according to the determination obtained by said determining means every given cycle, said measuring means measures said duration by incrementing a count of said counter.

6. A control method of a control device for controlling pieces of controlled apparatus performing communications within a network, comprising the steps of:

a determining step for determining whether said

controlled apparatus is normally controlled corresponding to a signal from said control device;

a measuring step for measuring a duration of abnormally controlled period of time when it is determined in said determining step that said controlled apparatus is abnormally controlled corresponding to the signal from the control device; and

a deallocating step for deallocating identifier allocated to said controlled apparatus for identifying said controlled apparatus when the duration measured in said measuring step exceeds a predetermined period of time.

7. The control method according to claim 6, characterized in that the signal from said control device is a sending permission signal to said controlled apparatus.

8. The a control method according to claim 6, characterized in that the control method further comprises a use-restriction-lifting step for lifting a use restriction on the controlled apparatus to allow the identifier deallocated in the deallocating step to be allocated to any of said pieces of controlled apparatus after a predetermined period of time has elapsed.

9. The control device according to claim 8, characterized in that, in said use-restriction-lifting step, data indicating

a use condition of said identifier, said data being stored in said storage means, is changed to data indicating unallocated condition when said deallocated identifier is allocated to any of said pieces of controlled apparatus.

10. The control method according to claim 6, characterized in that said determination is carried out in said determining step every given cycle; and

that, in said measuring step, when said controlled apparatus is found to be abnormally controlled corresponding to the signal from said control device according to the determination obtained in said determining step every given cycle, said duration is measured by incrementing a count of said counter.

11. A computer-readable medium for recording a program allowing a computer in a control device for controlling pieces of controlled apparatus performing communications within a network to carry out the steps of:

a determining step for determining whether said controlled apparatus is normally controlled corresponding to a signal from said control device;

a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the determining step that said controlled apparatus is abnormally controlled corresponding to a signal from said control device;

and

a deallocating step for deallocating an identifier allocated to said controlled apparatus for identifying said controlled apparatus when the duration measured in the measuring step exceeds a predetermined period of time.

12. The computer-readable medium according to claim 11, characterized in that a computer-readable medium further records a program carrying out a use-restriction-lifting step for lifting a use restriction on said controlled apparatus to allow the identifier deallocated in the deallocating step to be allocated to any of said pieces of controlled apparatus after a predetermined period of time has elapsed.

13. An information processing apparatus connected to a control device through a network and controlled by the control device comprising:

a determining means for determining whether it is normally controlled corresponding to a signal from said control device;

a measuring means for measuring a duration of abnormally controlled period of time when said determining means determines that it is abnormally controlled corresponding to a signal from said control device; and

a deallocating means for deallocating an identifier allocated thereto from the control device when the duration measured by the measuring means exceeds a predetermined period

of time.

14. The information processing apparatus according to claim 13, characterized in that the signal from said control device is a sending permission signal.

15. The information processing apparatus according to claim 13, characterized in that said determining means carries out said determination every given cycle; and

that said measuring means is provided with a counter for measuring said duration and when said controlled apparatus is found to be abnormally controlled corresponding to the signal from the control device according to the determination obtained by said determining means every given cycle, said measuring means measures said duration by incrementing a count of said counter.

16. An information processing method of an information processing apparatus connected to a control device through a network and controlled by the control device comprising the steps of:

a determining step for determining whether it is normally controlled corresponding to a signal from said control device;

a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the determining step that said controlled apparatus is abnormally controlled corresponding to a signal from said control device;

and

a deallocating step for deallocating an identifier allocated thereto from the control device when the duration measured in the measuring step exceeds a predetermined period of time.

17. The information processing method according to claim 16, characterized in that the signal from said control device is a sending permission signal.

18. The information processing method according to claim 16, characterized in that said determination is carried out in said determining step every given cycle; and

that, in said measuring step, when said controlled apparatus is found to be abnormally controlled corresponding to the signal from said control device according to the determination obtained in said determining step every given cycle, said duration is measured by incrementing a count of said counter.

19. A computer-readable medium for recording a program for allowing a computer in an information processing apparatus connected to a control device through a network and controlled by the control device to carry out the steps of:

a determining step for determining whether it is normally controlled corresponding to a signal from said control device,

a measuring step for measuring a duration of abnormally controlled period of time when it is determined in the determining step that it is abnormally controlled, and

a deallocating step for deallocating an identifier allocated thereto from said control device when the duration measured in said measuring step exceeds a predetermined period of time.

20. A communication system comprising a control device and pieces of controlled apparatus controlled by said control device in which each of the device and the apparatus are communicated with each other,

said control device including:

a first determining means for determining whether said controlled apparatus is normally controlled corresponding to a signal from said control device;

a first measuring means for measuring a duration of abnormally controlled period of time when said first determining means determines that said controlled apparatus is abnormally controlled corresponding to a signal from said control device; and

a first deallocating means for deallocating an identifier allocated to said controlled apparatus for identifying the controlled apparatus when the duration measured by the first measuring means exceeds a first predetermined period of time, and

said controlled apparatus device including:

a second determining means for determining whether it is normally controlled corresponding to a signal from said control device;

a second measuring means for measuring a duration of abnormally controlled period of time when the second determining means determines that it is abnormally controlled; and

a second deallocating means for deallocating an identifier allocated thereto from said control device when the duration measured by the second measuring means exceeds a second predetermined period of time.

21. The communication system according to claim 20, characterized in that the signal from said control device is a sending permission signal to said controlled apparatus.

22. The communication system according to claim 20, characterized in that the control device further comprises a use-restriction-lifting mans for lifting a use restriction on the controlled apparatus to allow the identifier deallocated by the first deallocating means to be allocated to any of said pieces of controlled apparatus after a third predetermined period of time longer than the second predetermined period of time has elapsed.

ABSTRACT

The present invention relates to a control device or the like, which are preferably applied to, for example, a wireless network. Control node determines whether the controlled node is normally controlled corresponding to a signal from the control node such as a sending permission signal (S82and S83). The control node measures a duration of abnormally controlled period of time (S84). The control node forcefully deallocates the node ID allocated to the controlled apparatus (S96) when the measured duration exceeds a predetermined period of time (a count of the monitoring counter exceeds a default value). The forcefully deallocated node ID may be allocated to a controlled node newly entered into the network after a predetermined period of time has been elapsed.

This allows the controlled node in poor communication condition to be eliminated from the network, thereby avoiding the waste communication and improving the efficiency of communication.

S99P0190US00

09/403813

FIG. 1

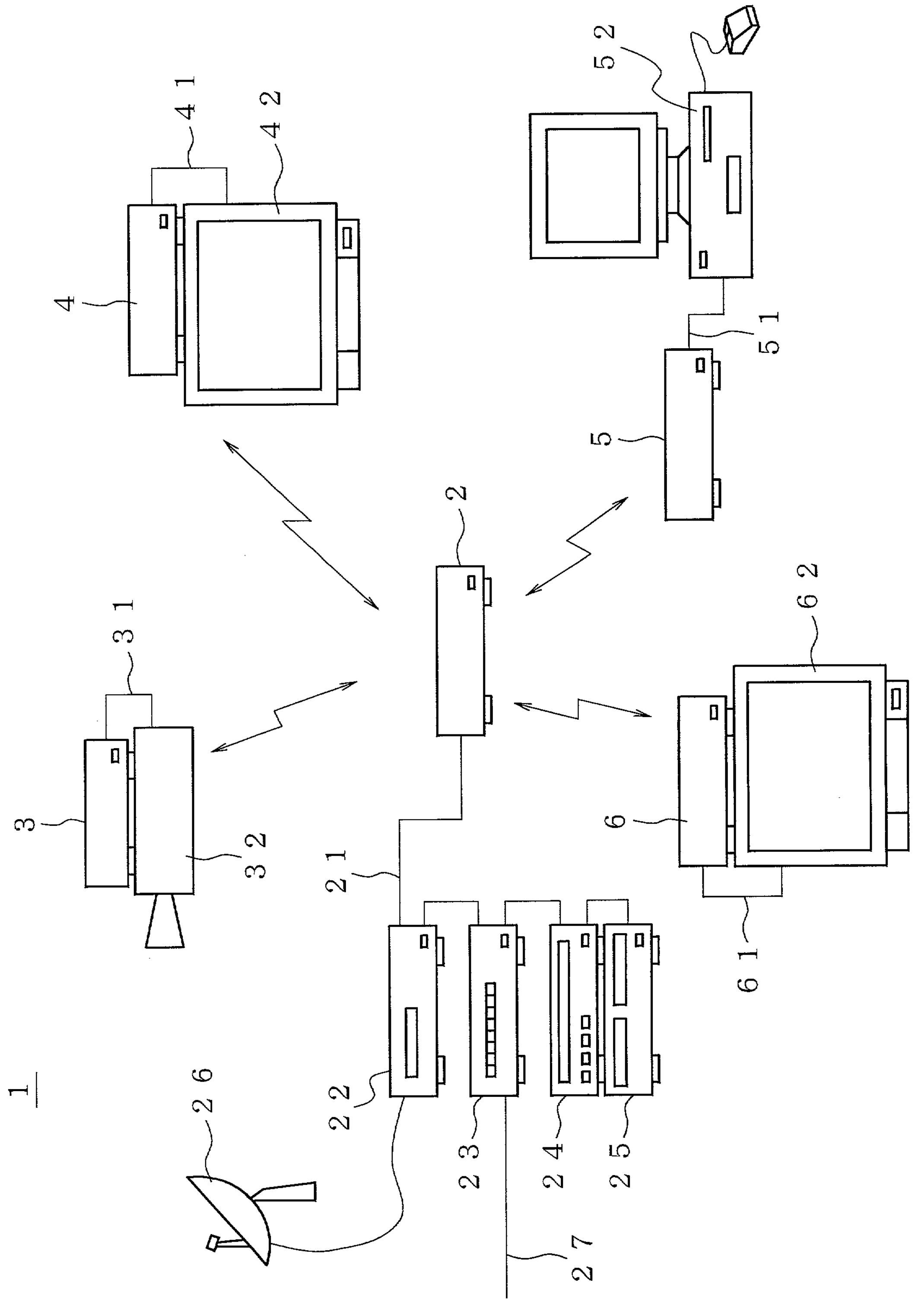
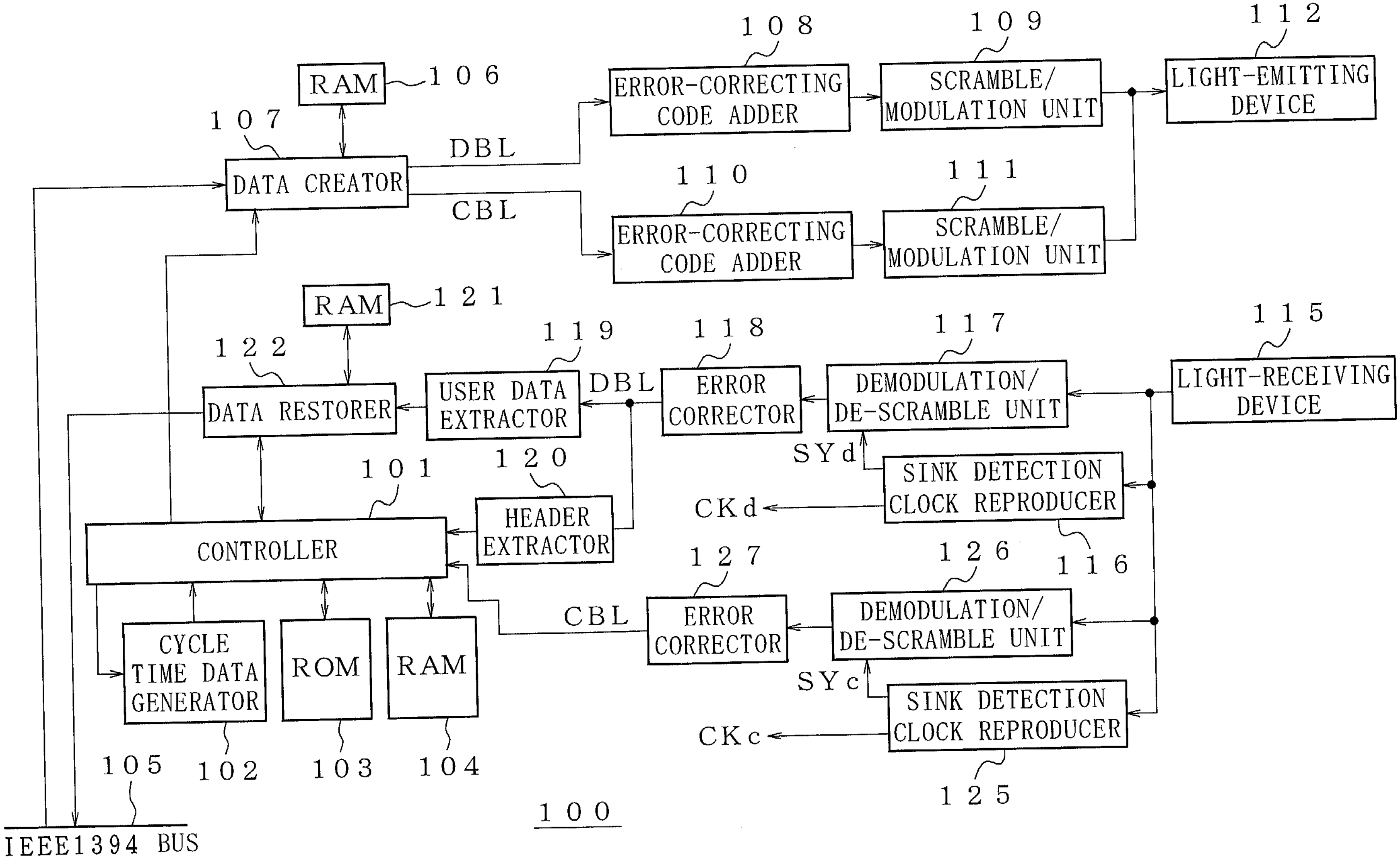
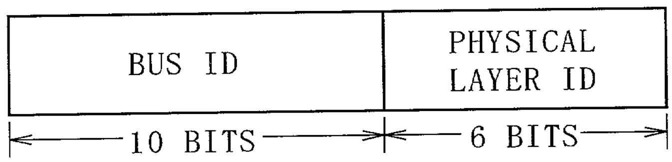


FIG. 2



RAM
106
107
DATA CREATOR
DBL
CBL
108
ERROR-CORRECTING CODE ADDER
110
ERROR-CORRECTING CODE ADDER
109
SCRAMBLE/ MODULATION UNIT
111
SCRAMBLE/ MODULATION UNIT
112
LIGHT-EMITTING DEVICE
RAM
121
122
DATA RESTORER
119
USER DATA EXTRACTOR
DBL
118
ERROR CORRECTOR
117
DEMODULATION/ DE-SCRAMBLE UNIT
115
LIGHT-RECEIVING DEVICE
SYd
SINK DETECTION CLOCK REPRODUCER
CKd
116
101
CONTROLLER
120
HEADER EXTRACTOR
127
ERROR CORRECTOR
CBL
126
DEMODULATION/ DE-SCRAMBLE UNIT
SYc
SINK DETECTION CLOCK REPRODUCER
CKc
125
CYCLE TIME DATA GENERATOR
ROM
RAM
105
102
103
104
IEEE1394 BUS
100

F I G. 3



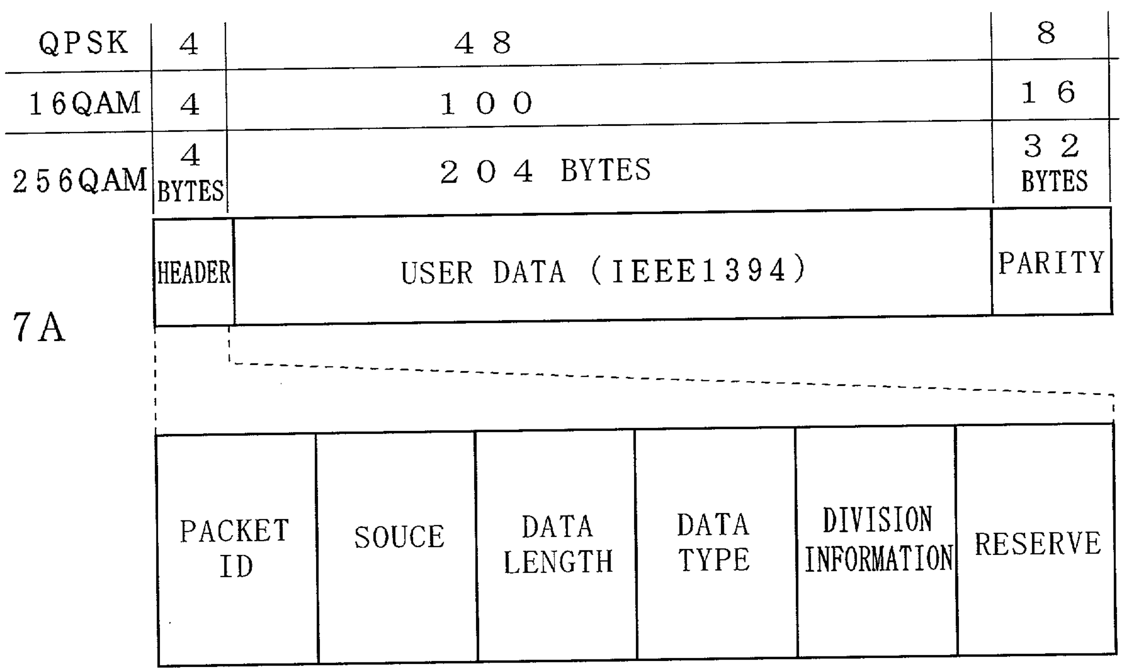


FIG. 7A

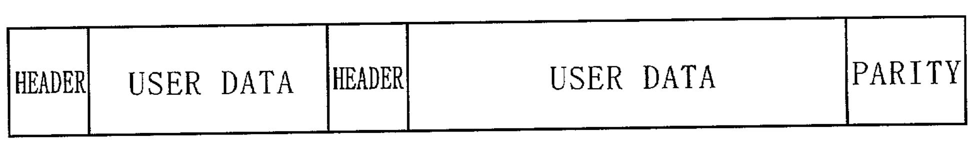


FIG. 7B

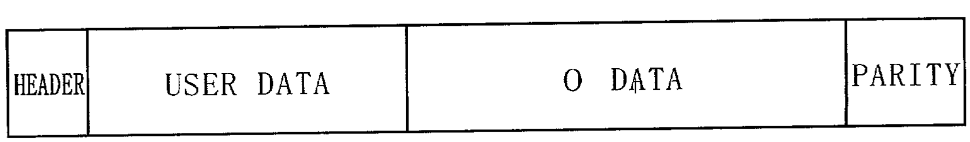
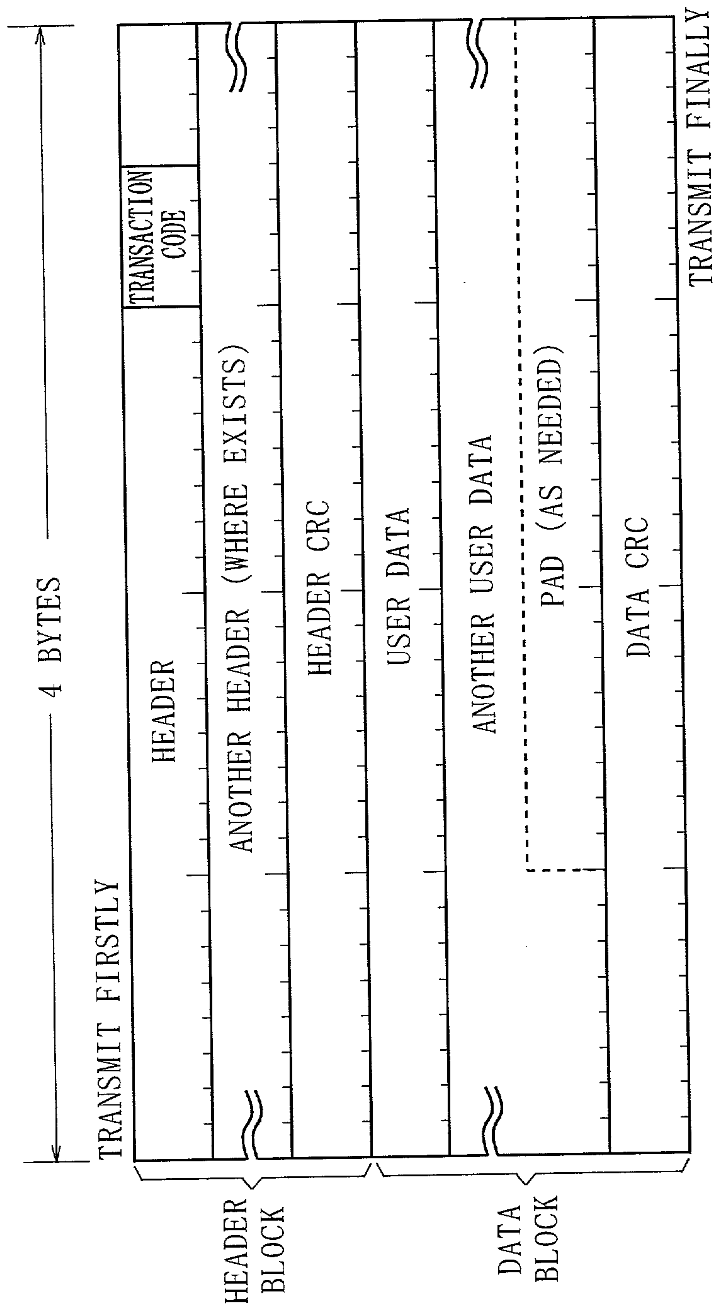


FIG. 7C

FIG. 4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TRANSMIT FIRSTLY
TRANSMIT FINALLY
HEADER
TRANSACTION CODE
ANOTHER HEADER (WHERE EXISTS)
HEADER CRC
USER DATA
ANOTHER USER DATA
PAD (AS NEEDED)
DATA CRC
HEADER BLOCK
DATA BLOCK

09/403813

FIG. 5

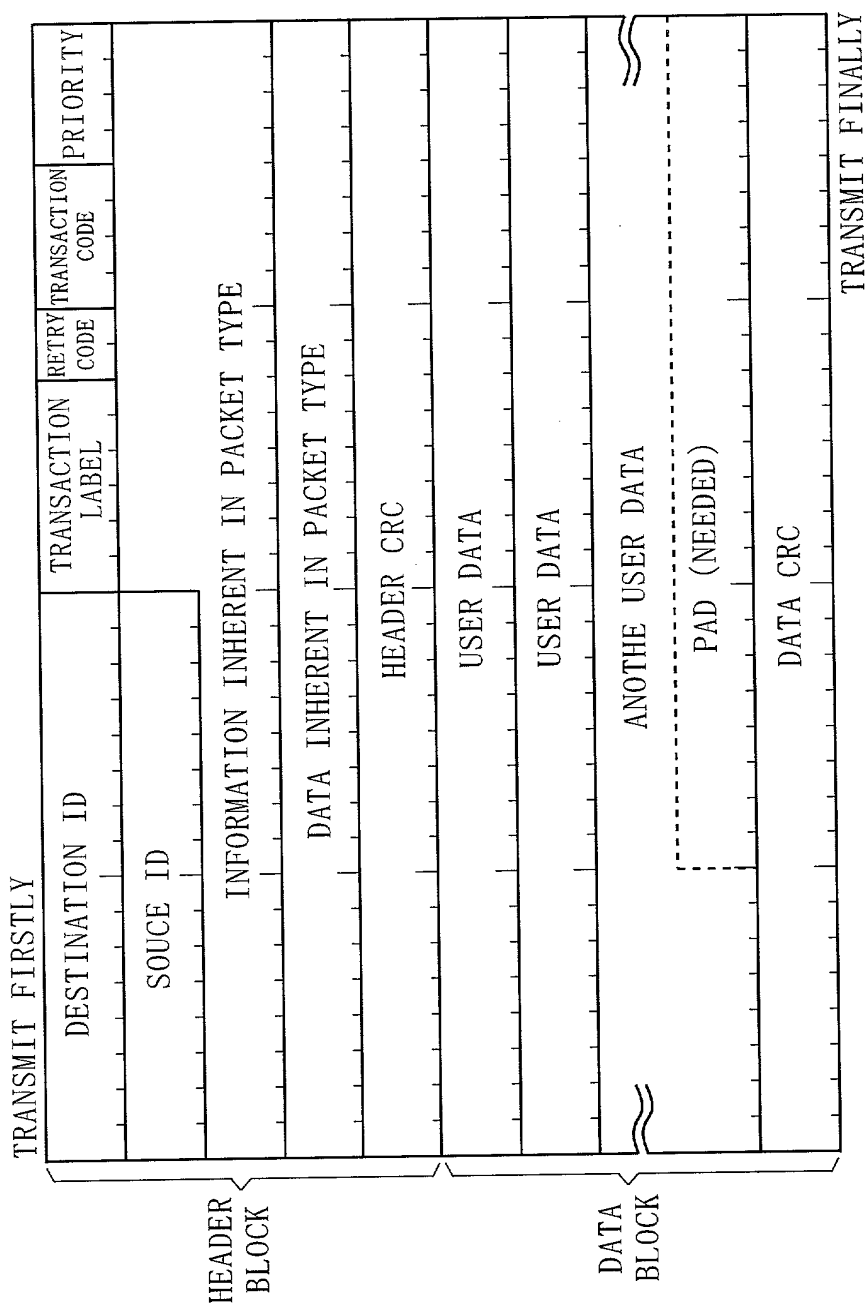
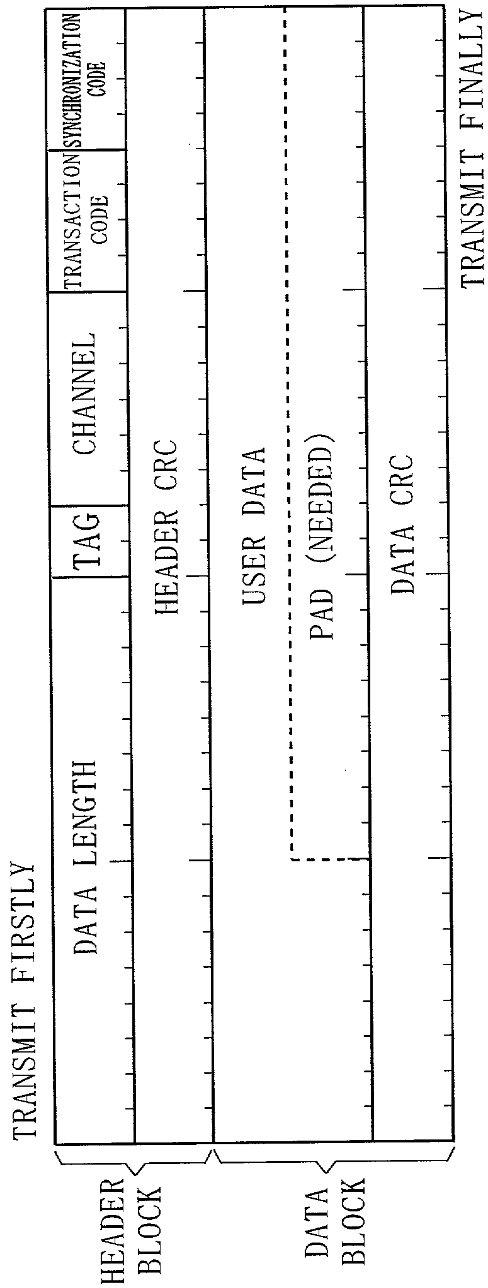


FIG. 6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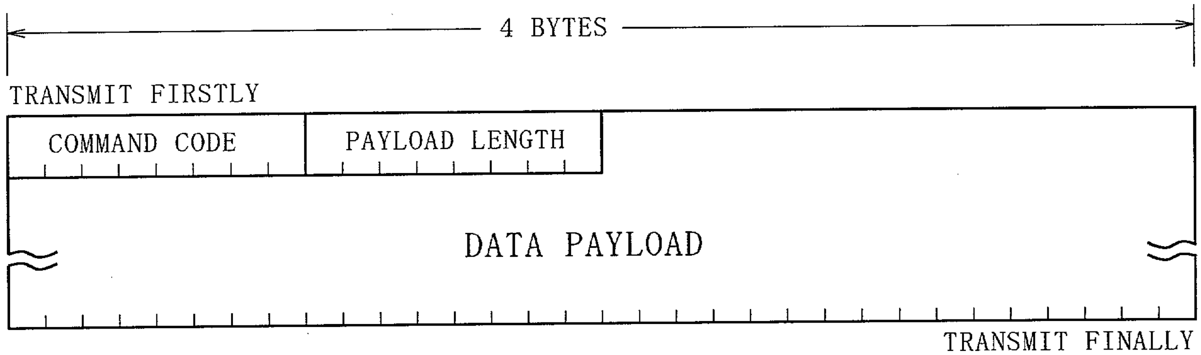
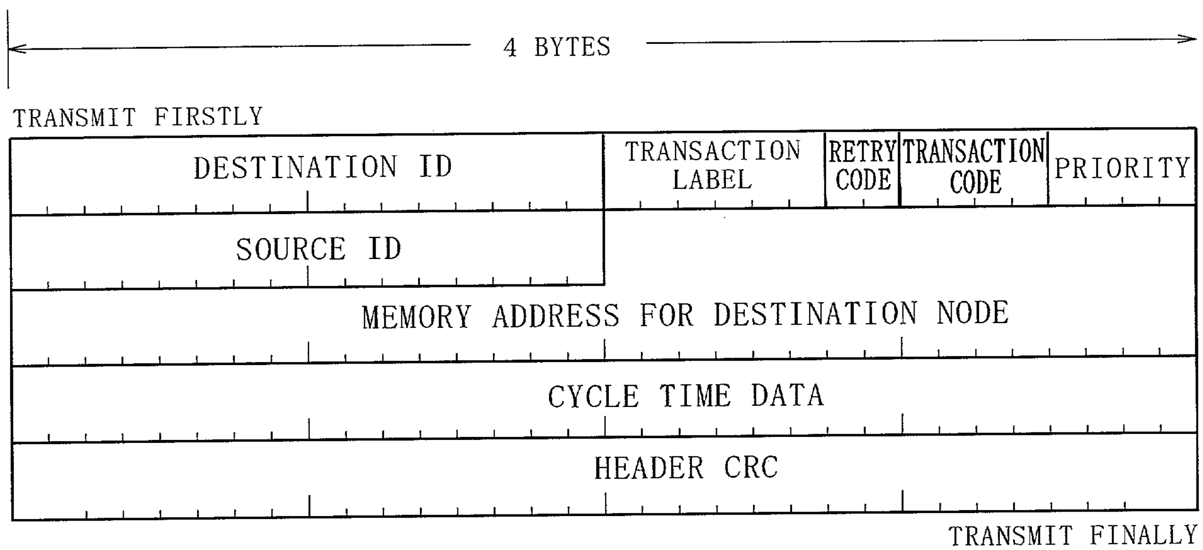
DATA LENGTH
TAG
CHANNEL
TRANSACTION CODE
SYNCHRONIZATION CODE
HEADER CRC
USER DATA
PAD (NEEDED)
DATA CRC
TRANSMIT FINALLY
HEADER BLOCK
DATA BLOCK

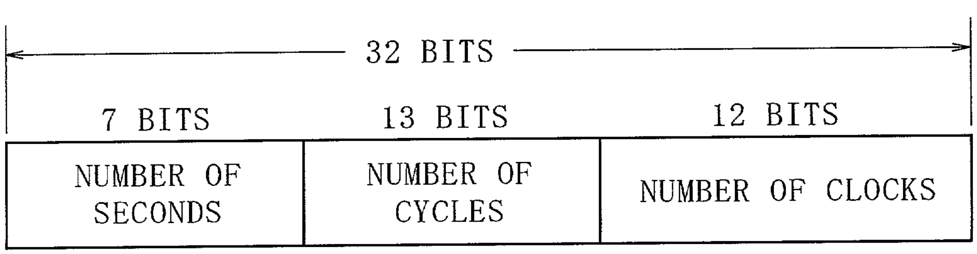
F I G. 8



F I G. 1 0



F I G. 1 1



F I G . 9

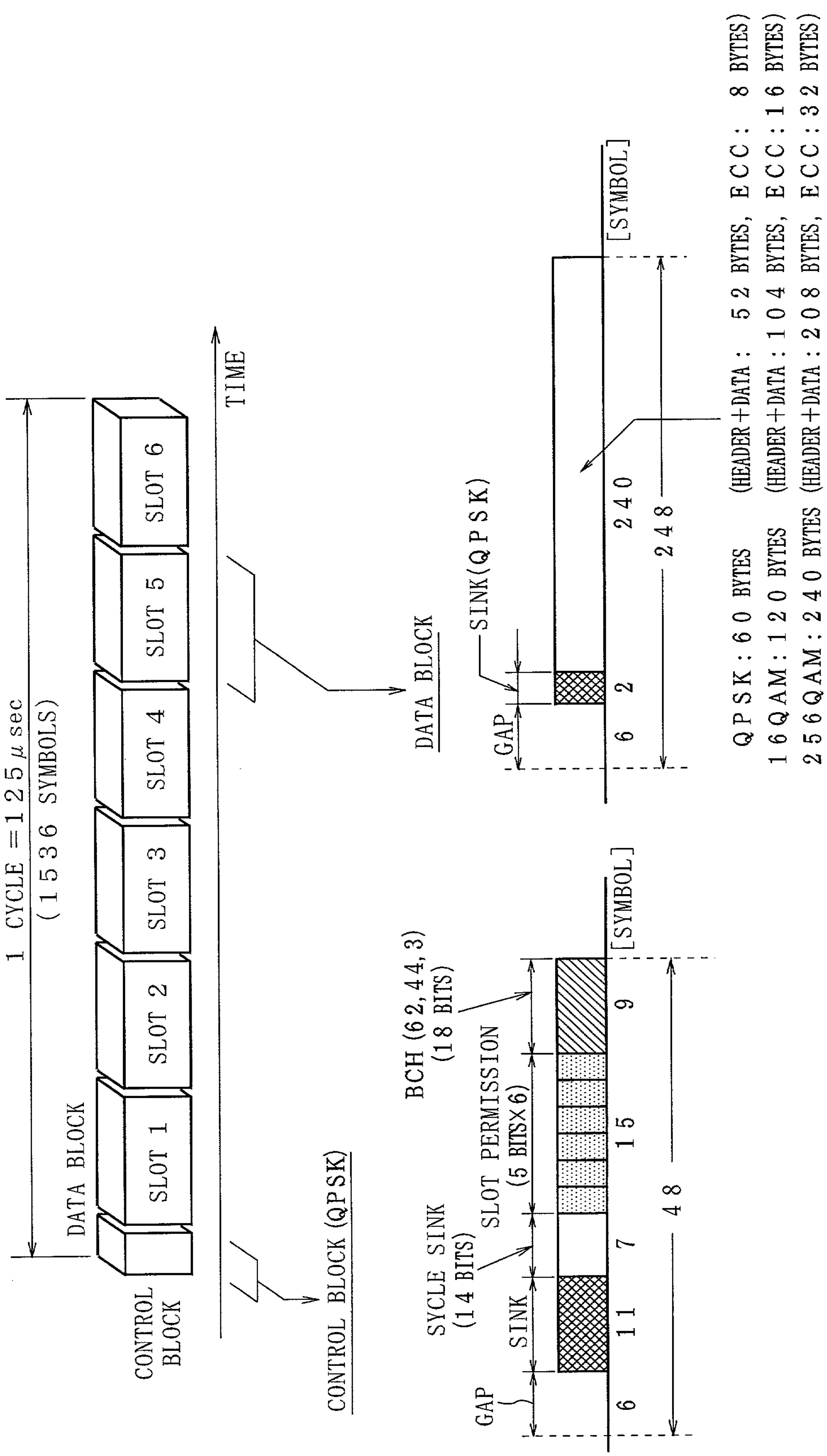

1 CYCLE =125 μsec
(1536 SYMBOLS)
DATA BLOCK
CONTROL BLOCK
SLOT 1
SLOT 2
SLOT 3
SLOT 4
SLOT 5
SLOT 6
TIME
CONTROL BLOCK (QPSK)
DATA BLOCK
GAP
SINK
SYCLE SINK
(14 BITS)
SLOT PERMISSION
(5 BITS×6)
BCH (62, 44, 3)
(18 BITS)
6
11
7
15
9
48
[SYMBOL]
GAP
SINK(QPSK)
6
2
240
248
[SYMBOL]
QPSK:60 BYTES (HEADER+DATA: 52 BYTES, ECC: 8 BYTES)
16QAM:120 BYTES (HEADER+DATA:104 BYTES, ECC:16 BYTES)
256QAM:240 BYTES (HEADER+DATA:208 BYTES, ECC:32 BYTES)

FIG. 12

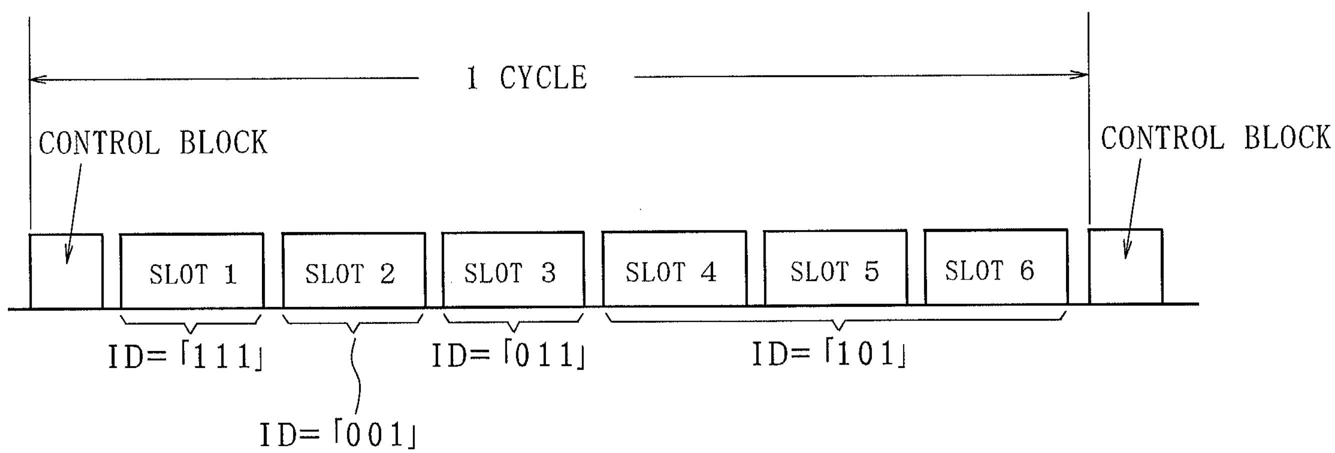

1 CYCLE
CONTROL BLOCK
CONTROL BLOCK
SLOT 1
SLOT 2
SLOT 3
SLOT 4
SLOT 5
SLOT 6
ID=「111」
ID=「001」
ID=「011」
ID=「101」

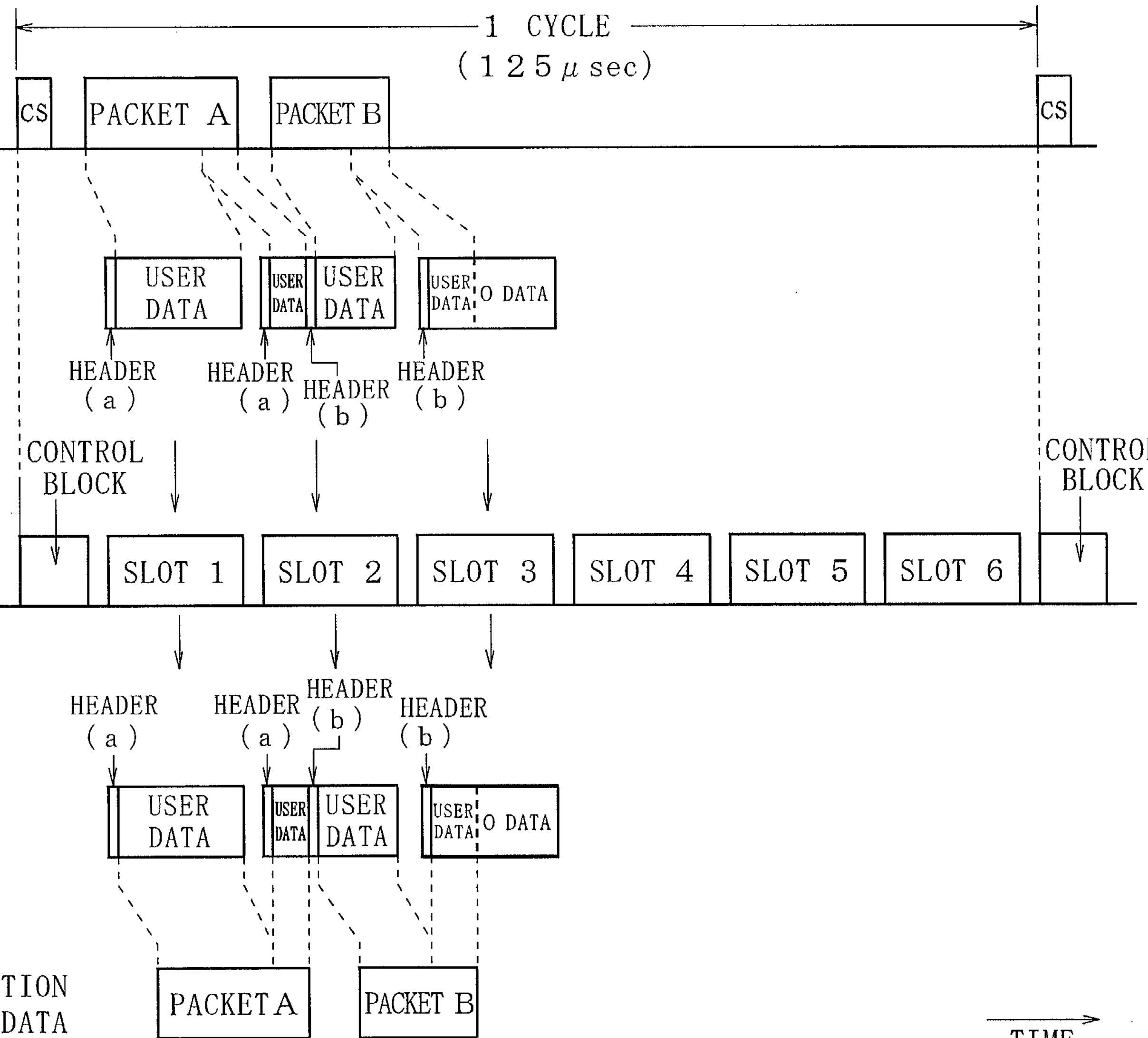
FIG.13A PACKET DATA

FIG.13B DATA BLOCK

FIG.13C

FIG.13D

FIG.13E RECONSTRUCTION OF PACKET DATA



F I G. 1 4

NODE ID FOR RADIO COMMUNICATION	FIRST STORAGE AREA (USE FLAG)	SECOND STORAGE AREA (FREQUENCY INFORMATION)	THIRD STORAGE AREA (MONITORING COUNTER)	FORTH STORAGE AREA (DELAYING COUNTER)
0 0 1	1	1 1 (HIGH)	0	c
0 1 0	1	1 0 (NOMAL)	a	0
0 1 1	1	0 0 (LOW)	b	0
1 0 0	0	0 0	0	0
1 0 1	0	0 0	0	0
1 1 0	0	0 0	0	0
1 1 1	1	1 0		

F I G. 1 6

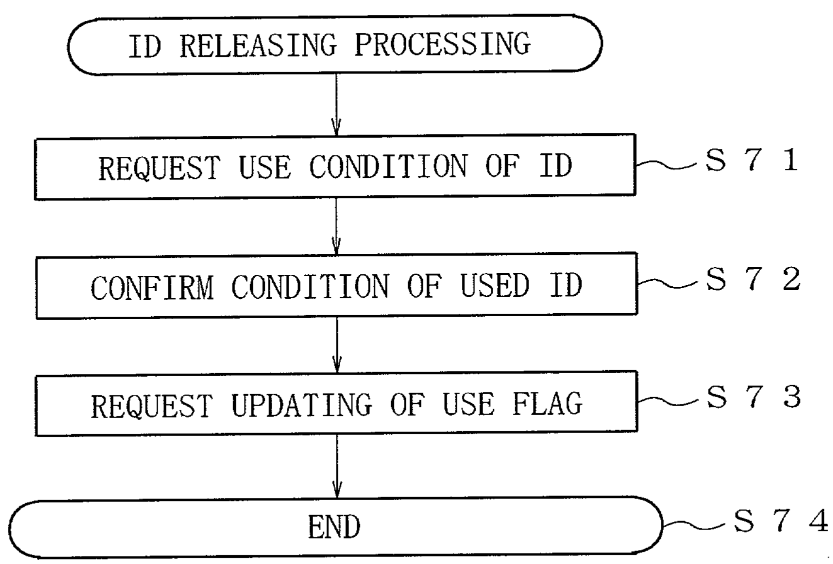


FIG. 15

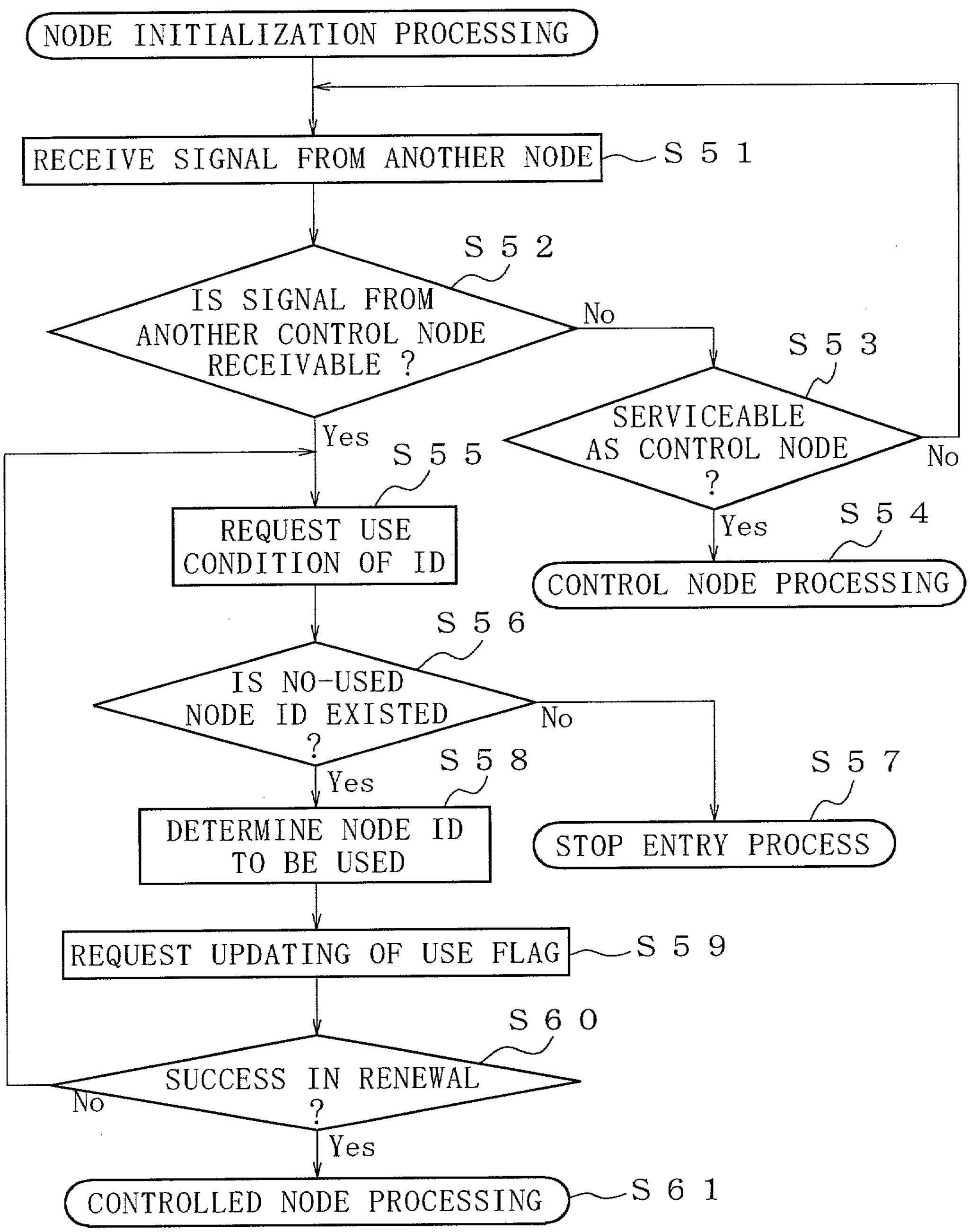

NODE INITIALIZATION PROCESSING
RECEIVE SIGNAL FROM ANOTHER NODE
S51
S52
IS SIGNAL FROM ANOTHER CONTROL NODE RECEIVABLE ?
No
S53
SERVICEABLE AS CONTROL NODE ?
No
Yes
S55
Yes
S54
REQUEST USE CONDITION OF ID
CONTROL NODE PROCESSING
S56
IS NO-USED NODE ID EXISTED ?
No
Yes
S58
S57
DETERMINE NODE ID TO BE USED
STOP ENTRY PROCESS
REQUEST UPDATING OF USE FLAG
S59
S60
SUCCESS IN RENEWAL ?
No
Yes
CONTROLLED NODE PROCESSING
S61

FIG. 17

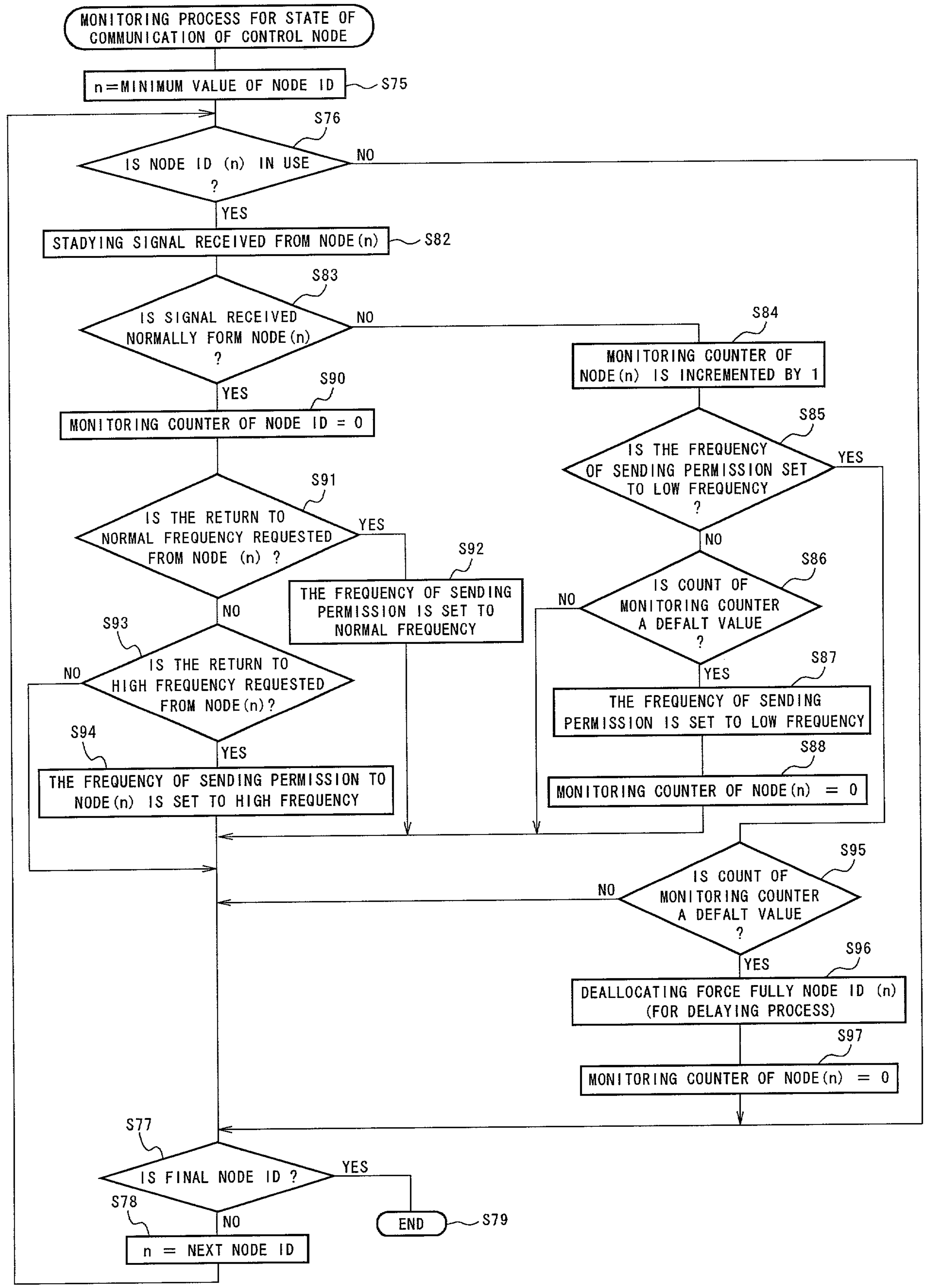
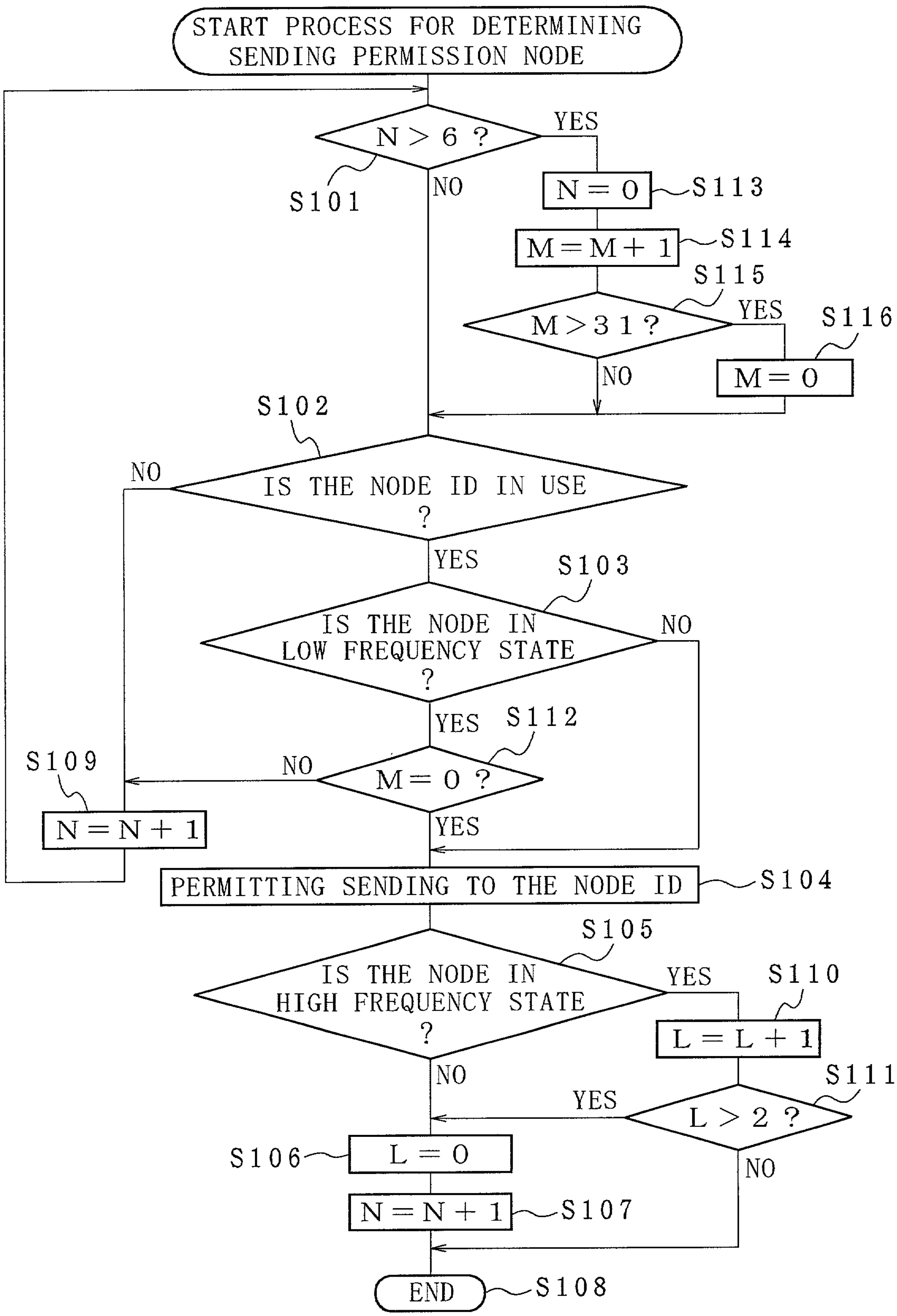

MONITORING PROCESS FOR STATE OF COMMUNICATION OF CONTROL NODE
n=MINIMUM VALUE OF NODE ID
S75
S76
IS NODE ID (n) IN USE ?
NO
YES
STADYING SIGNAL RECEIVED FROM NODE(n)
S82
S83
IS SIGNAL RECEIVED NORMALLY FORM NODE(n) ?
NO
YES
S84
MONITORING COUNTER OF NODE(n) IS INCREMENTED BY 1
S90
MONITORING COUNTER OF NODE ID = 0
S85
IS THE FREQUENCY OF SENDING PERMISSION SET TO LOW FREQUENCY ?
YES
NO
S91
IS THE RETURN TO NORMAL FREQUENCY REQUESTED FROM NODE (n) ?
YES
NO
S92
THE FREQUENCY OF SENDING PERMISSION IS SET TO NORMAL FREQUENCY
S86
IS COUNT OF MONITORING COUNTER A DEFALT VALUE ?
NO
YES
S93
IS THE RETURN TO HIGH FREQUENCY REQUESTED FROM NODE(n)?
NO
YES
S87
THE FREQUENCY OF SENDING PERMISSION IS SET TO LOW FREQUENCY
S94
THE FREQUENCY OF SENDING PERMISSION TO NODE(n) IS SET TO HIGH FREQUENCY
S88
MONITORING COUNTER OF NODE(n) = 0
S95
IS COUNT OF MONITORING COUNTER A DEFALT VALUE ?
NO
YES
S96
DEALLOCATING FORCE FULLY NODE ID (n) (FOR DELAYING PROCESS)
S97
MONITORING COUNTER OF NODE(n) = 0
S77
IS FINAL NODE ID ?
YES
NO
END
S79
S78
n = NEXT NODE ID

FIG. 18


START PROCESS FOR DETERMINING SENDING PERMISSION NODE
N > 6 ?
S101
YES
NO
N = 0
S113
M = M + 1
S114
S115
M > 31 ?
YES
S116
M = 0
NO
S102
IS THE NODE ID IN USE ?
NO
YES
S103
IS THE NODE IN LOW FREQUENCY STATE ?
NO
YES
S112
M = 0 ?
NO
S109
N = N + 1
YES
PERMITTING SENDING TO THE NODE ID
S104
S105
IS THE NODE IN HIGH FREQUENCY STATE ?
YES
S110
L = L + 1
S111
L > 2 ?
YES
NO
NO
S106
L = 0
N = N + 1
S107
END
S108

09/403813

FIG. 19

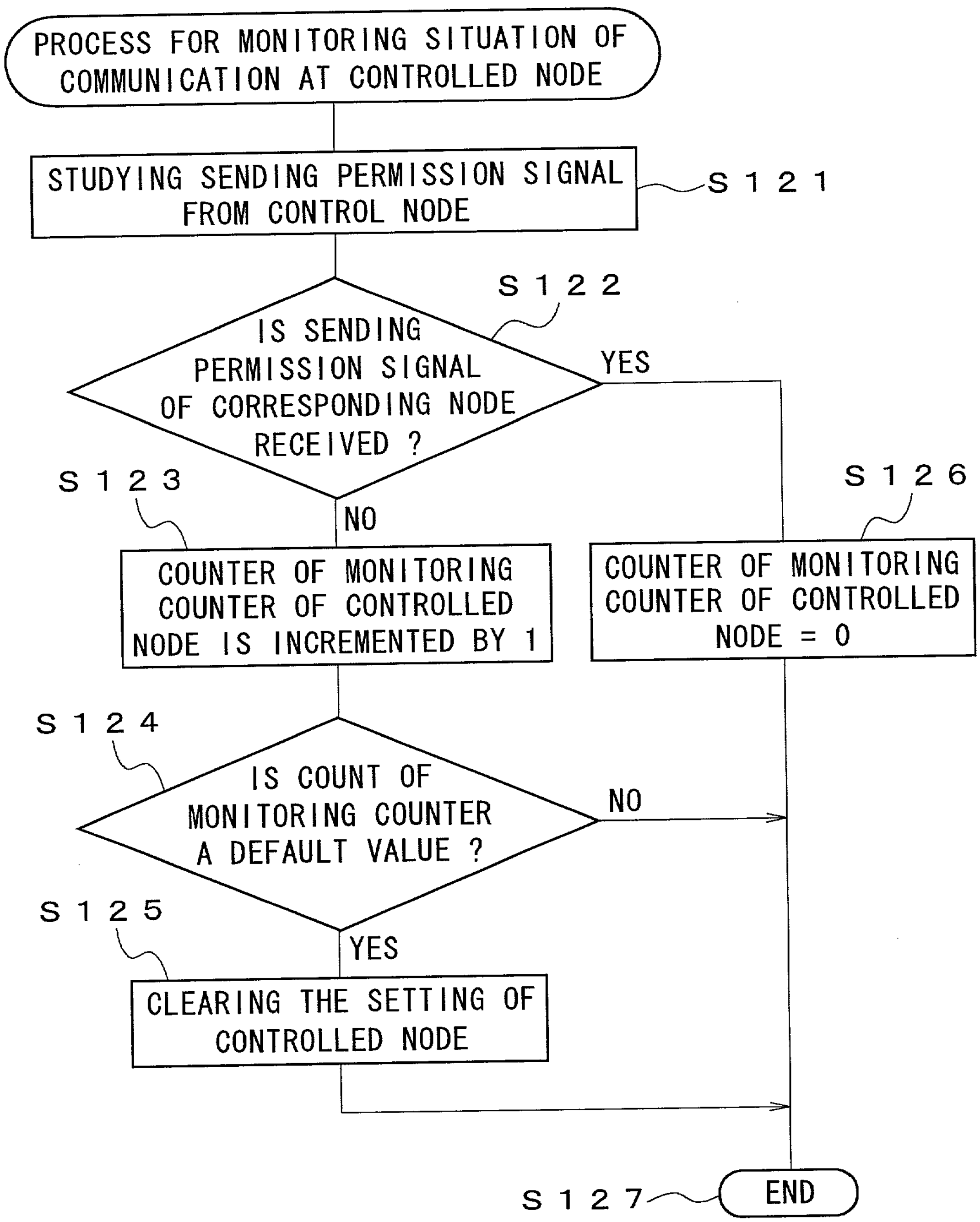
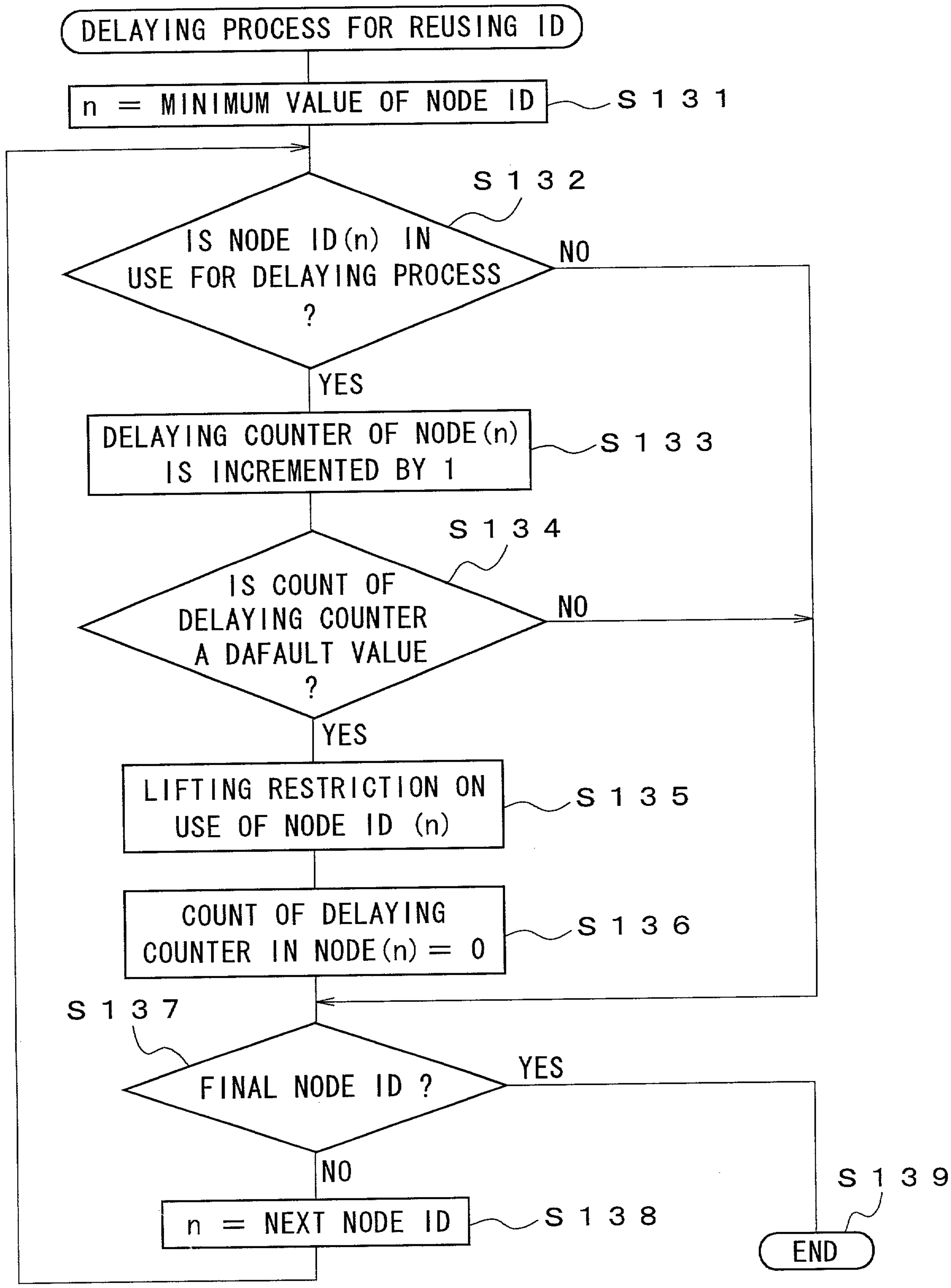


FIG. 20


DELAYING PROCESS FOR REUSING ID
n = MINIMUM VALUE OF NODE ID
S131
S132
IS NODE ID(n) IN USE FOR DELAYING PROCESS ?
NO
YES
DELAYING COUNTER OF NODE(n) IS INCREMENTED BY 1
S133
S134
IS COUNT OF DELAYING COUNTER A DAFAULT VALUE ?
NO
YES
LIFTING RESTRICTION ON USE OF NODE ID (n)
S135
COUNT OF DELAYING COUNTER IN NODE(n) = 0
S136
S137
FINAL NODE ID ?
YES
NO
n = NEXT NODE ID
S138
S139
END

S99P0190US00
7449/57723

DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CONTROL DEVICE, CONTROL METHOD, INFORMATION PROCESSING APPARATUS, INFORMATION PROCESSING METHOD, COMMUNICATION SYSTEM AND COMPUTER-READABLE MEDIUM

The specification of which
(check one)

____ is attached hereto.

_X_ was filed on October 26, 1999 (International Filing Date) as

International Application No. PCT/JP99/00952

corresponding to U.S. Serial No. 09/403,813

and was amended on ____________________
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

			Priority Claimed	
Number	**Country**	**Filing Date**	**Yes**	**No**
P10-046678	Japan	February 27, 1998	X	

Declaration and Power of Attorney

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status

And I hereby appoint Jay H. Maioli, Reg. No. 27,213; Donald S. Dowden, Reg. No. 20,701; William E. Pelton, Reg. No. 25,702; Peter J. Phillips, Reg. No. 29,691; Gerald W. Griffin, Reg. No. 18,886; Ivan S. Kavrukov, Reg. No. 25,161; Christopher C. Dunham, Reg. No. 22,031; Norman H. Zivin, Reg. No. 25,385; John P. White, Reg. No. 28,678; and Robert D. Katz, Reg. No. 30,141; and each and all of them, all c/o Cooper & Dunham, 1185 Avenue of the Americas, New York, NY 10036 (Tel. (212) 278-0400), my attorneys, each with full power of substitution and revocation, to receive the patent, to transact all business in the Patent and Trademark Office connected therewith and to file any International Applications which are based thereon under the provisions of the Patent Cooperation Treaty.

(10)

Please address all communications, and direct all telephone calls, regarding this application to

JAY H. MAIOLI
Cooper & Dunham LLP
1185 Avenue of the Americas
New York, New York 10036
Tel. (212) 278-0400

Reg. No. 27,213

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or First joint inventor: Masatoshi Ueno

1-60

Inventor's signature: Masatoshi Ueno

Citizenship: Japanese

Date of Signature: Dec. 21, 1999

Residence: Tokyo, Japan

JPY

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7449/57723

Post Office Address ~~c/o Sony Corporation, 7-35 Kitashinagawa, 6-Chome,~~
~~Shinagawa-ku, Tokyo, Japan~~